

February 9, 1959

Aviation Week

Including Space Technology

**AZUSA Plots
Missile's
Impact Area**

•
Convair Atlas
Production Line

75 Cents

A McGraw-Hill Publication



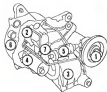


CONVAIR B-58 HUSTLER and CONVAIR ATLAS ICBM

PARTNERS FOR PEACE...manned and unmanned!

Long range planning of yesterday by the U. S. Air Force is taking shape today in *manned and unmanned* weapons systems such as Convair's B-58 Hustler—our first supersonic bomber, and Convair's Atlas—the *free world's first intercontinental Ballistic Missile!* In utilizing the outstanding features of both systems, this unmatched combination offers the Air Force maximum flexibility in carrying out its Strategic Mission. These partners for peace, both *manned and unmanned*, integrated into a single instrument of defense, play a vital role in keeping the free world free!

CONVAIR



1 — INPUT SHAFT

Accepts varying input speeds from 2800-7000 RPM.

2 — GOVERNOR

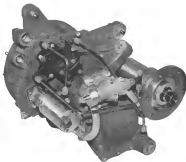
Maintains $\pm 0.05\%$ steady state speed over 300° F temp. range, $\pm 0.5\%$ for 400° F temp. range and 0.5 second maximum full load transient recovery time.

3 — VARIABLE DISPLACEMENT PUMP/MOTOR

Idle pump or motor, depending on whether it is adding to or subtracting from drive speed.

4 — OVERSPEED GOVERNOR

Senses a predetermined excessive speed to prevent drive overspeeding.



5 — MAIN SYSTEM RELIEF VALVE

Overload protection for hydraulic system.

6 — DIFFERENTIAL GEAR SECTION

Eng. sun and planet gears. Also includes take off gears for governors, convergence and make-up pumps.

7 — FIXED DISPLACEMENT MOTOR/PUMP

Drives, or is driven by, sun gear to control output speed at 4000 rpm in response to fuel flow exchange with variable delivery unit.

A SIGNIFICANT ADVANCEMENT—

Differential Type Constant Speed Drive For Aircraft Alternators

Tests now in progress on this 60 kw Vickers Differential Type Constant Speed Drive are proving its outstanding performance. (See cover) It combines Vickers dependable hydraulic pumps and motors with planetary gearing to provide more efficient and lighter "package" than drives now available.

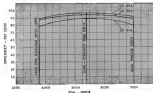
The differential type constant speed drive is a direct engine-driven transmission that can be either engine gear mounted or universal shaft drives. It employs the "differential drive" principle wherein the planetary gear train is the principal power vehicle and the hydraulic components differentially add or subtract speed and power to maintain constant output speed. For further information, write for Bulletin A-5221.

VICKERS INCORPORATED

DIVISION OF SPIEGEL & BURDETT CORPORATION

Air & Hydraulic Division

Engineering, Sales and Service Offices
A Division of SPIEGEL & BURDETT CORPORATION
Department 100 • Denver 22, Colorado
TOLSON, CALIFORNIA • 7001 Santa Barbara
P.O. Box 3005 • Torrance, California



Performance of Vickers 60 kw Differential Type Constant Speed Drive at three different loads. The high efficiency requires minimum support equipment for cooling with minimum penalty for high temperature operation (400° F oil temp.)

THE WORLD'S LARGEST ANTENNAS ARE COMING FROM KENNEDY

Kennedy builds them big — to meet the expanding needs of electronics. And Kennedy builds them rugged — to withstand the most demanding conditions of service. Kennedy's facilities and engineering skills are devoted to serving the electronics trade in the development, design, manufacture and installation of all types of antenna systems.

KENNEDY WAVE GUIDE COMPONENTS...



where high standard precision, known, standard waveguide construction is required.

- Smooth lead systems - designed and installed
- Dual and triple pin-hole flange
- Translating
- Rectifiers
- Shielded waveguide and leads
- Sample isolators

*For more complete information,
and for your free copy
of the handy file-size
Kennedy antenna Equipment
Folder.*



West Coast Office
SATELLITE-KENNEDY, INC., 44 CALIFORNIA
P.O. Box 9711, Monterey, California • Phone 2-5281

- Radio Receivers
27, 10, 14, 40
- Mobile Antennas 27
- Radio Antennas
27, 10, 14
- Trucking Radio Antennas
27, 10, 14
- Flat Top Antennas
10, 14, 27 and 40

AVIATION CALENDAR

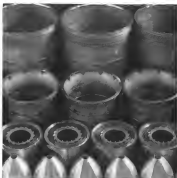
Feb. 20-23-4th Annual Pacific Coast Ship
Winter Session, Chongchong, Tokyo
Piers Club, San Diego, Calif.
Feb. 22-24-8th Annual Texas Agricultural
Aviation Conference, Winona, Minn.
Feb. 22-24-8th Annual Texas Agricultural
Aviation Conference, Winona, Minn.
Feb. 23-26-1959 Annual Symposium on
Thermal Properties, Purdue University,
Lafayette, Ind. Sponsors: Heat Transfer
Division of American Society of Mechanical
Engineers
Feb. 25-March 3-1959 Engineering Exposition,
Bobby Park, San Diego, Calif. All
shows sponsored by the U.S. Navy, Navy
San Diego, Calif.
March 3-5-1959 American Joint Computer
Conference, sponsored by Institute of
Radio Engineers, American Society of
Electrical Engineers and Van Nuys
County, Van Nuys, Calif.
March 3-6-Flight Propulsion Meeting (to
be held) Institute of the Aeronautical Sci-
ences, Moffett Field, Calif.
March 4-5-Aviation Space Age Conference
and Exhibit, For information: Director
Trade Dept., Los Angeles Chamber of
Commerce, 401 South Hill St., Los
Angeles 58, Calif.
March 4-18-California Power Conference
and Exhibit, Northridge Hilton Hotel,
Northridge, Calif. Sponsors: American
Society of Mechanical Engineers
March 9-12-Aviation Division Conference,
American Society of Mechanical Engi-
neers, Santa Monica Hotel, Los Angeles
March 10-11-Third Annual Shock Tube
Symposium, Old Post Club, Fort Worth,
Tex. For details: Aviation, Power
Special Weapons Group, Kirtland AFB,
Albuquerque, N.M. Attn: SMITH R. B.
Bartlett
March 14-17-Conference on the Nucleus
(Continued on page 6)

AVIATION WEEK Including Space Technology

February 5, 1959
Vol. 70, No. 6

Featured early with an additional page is the new
"Aviation Week" section, which is a special
feature of the magazine. It is a collection of
articles, reports, and news items, all of which
are of interest to the aviation industry. The
section is edited by the editor of the magazine,
and is published in the first issue of each
month. It is a valuable source of information
for anyone interested in the aviation industry.
The section is published in the first issue of
each month, and is a valuable source of
information for anyone interested in the
aviation industry. The section is published in
the first issue of each month, and is a
valuable source of information for anyone
interested in the aviation industry.

AVIATION WEEK, February 5, 1959



high temperature AVIATION COMPONENTS BY LAVELLE

Lavelle manufactures aviation components to meet the most critical demands of high temperature operation. Typical of the many high temperature units produced in quantity by experienced Lavelle craftsmen are the jet engine tail pipes, engine casings and heat exchangers shown above.

Lavelle specializes in the production of precision sheet metal weldments and assemblies made of titanium, aluminum, stainless steel, and heat-resistant nickel alloys... joined by welding methods applicable to specific component design and function. Where required, special tools are designed and fabricated by Lavelle to maintain production quality, reduce costs... and promote on-schedule delivery.

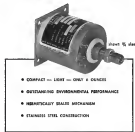
If your requirements for component performance demand the very highest standards of component workmanship, call on Lavelle... or write for brochure describing specialized skills and facilities ready to serve your needs.



LAVELLE AIRCRAFT CORPORATION • NEWTOWN, BUCKS COUNTY, PA.
Bellevue, Philadelphia, Pa., and Toms River, N.J.

Introduces

TYPE 78 PRESSURE POTENTIOMETERS FOR TELEMETRYING AND CONTROL APPLICATIONS



- COMPACT — LIGHT — ONLY 4 OUNCES
- OUTSTANDING ENVIRONMENTAL PERFORMANCE
- HERMETICALLY SEALED MECHANISM
- STAINLESS STEEL CONSTRUCTION

Type 78 Pressure Potentiometers feature accurate and reliable performance under severe environmental conditions:

Sinusoidal Vibration: 1" ϕ , 2 to 22 cps, 25 g, 22 to 2000 cps

Random Gaussian Vibration: 0.1 g/cps, 15 to 2000 cps

Sustained Acceleration: 50 g on any axis

Mechanical Shock: 30 g on any axis

Operating Temperature: -65 F to +160 F with minimum change in output

Hermetic sealing protects entire mechanism against sand and dust, humidity, salt spray, fungus, and the fluid being measured. Unit has welded stainless-steel case, is 1 1/4" diameter by 1 3/4" long, weighs only 6 ounces. Standard ranges are 0-15, 0-25, and 0-50 psi; other ranges available.

Write to Trans-Sonics, Inc., Dept. 7, Burlington, Mass., for further information on Type 78 Pressure Potentiometers.

TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

(Continued from page 3)

Optical Model: Florida State University, Tallahassee, Fla. Sponsored National Science Foundation Office of Naval Research, Air Force Office of Scientific Research/Naval Research Division. Publication of conference proceedings anticipated.

March 15-18: 11th Western Vandal Equations and Computers. American Society for Metals, San Francisco, California and San Francisco Hotel, Los Angeles, Calif.

March 15-15: Flight Testing Conference. American Society for Testing and Materials, Dayton, Ohio.

March 15-16: National Conference, Institute of Radio Engineers, Columbus, and Waldorf Astoria Hotel, New York, N. Y.

March 22-27: 19th Annual Conference, Pacific Coast Section of the Society of the Plastics Industry, Hotel del Coronado, San Diego, Calif.

March 21-Apr. 2: Polytecture Institute of Brooklyn's Ninth International Symposium, Subject: Materials, World Auditorium, Engineering Societies Bldg., New York, N. Y.

March 21-Apr. 2: National Automatic Meeting, Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 2-4: Conference on Electrically Isolated Wires, sponsored by the Thermal Radiation Laboratory of the Compton Research Division of the Air Force Cambridge Research Center, Bedford, Mass.

Apr. 5-10: 1959 Machine Congress, Municipal Auditorium, Cleveland, Ohio. For information: Engineers East Council, 26 West 5th St., New York 18, N. Y.

Apr. 7-10: 1959 Wildlife Show and 40th Annual Convention, American Wildlife Society, International Amphitheatre and Hotel Sherman, Chicago, Ill.

Apr. 12-16: Air Force Arm's World Conference, Las Vegas, Nev.

Apr. 12-22: Annual Meeting, American Society of Tied Engineers, Sheraton Hotel, Milwaukee, Wis.

Apr. 15-16: Spring Technical Conference on Electronic Data Processing, Computer Section of the Institute of Radio Engineers, Engineering Societies Bldg., Chicago, Ill.

Apr. 22-24: 1959 Annual Meeting, Institute of Pharmaceutical Engineers, LaSalle Hotel, Chicago, Ill.

Apr. 26-May 1: Controllable Self-Heating Core, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

May 4-6: National Automated Electronics Conference, Institute of Radio Engineers, Ballroom Hotel, Dayton, Ohio.

May 4-5: 1959 Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle, Wash.

May 5-7: Flying Vehicle, International Society of Radio Engineers, Waldorf Hotel, Washington, D. C.

May 6-8: 1959 Regional Conference and Trade Show, Section of Radio Engineers, University of New Mexico, Albuquerque, N. M.

June 12-14: 11th French Air Show, Le Bourget, Paris, France.

Able-One... a new apogee in scientific teamwork!

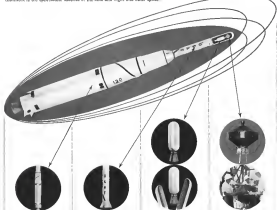
Preparation and execution of an undertaking such as the United States' 16th space probe demanded the participation

and exceptional efforts of 52 scientific and industrial firms and the Armed Forces, The Advanced Research

Projects Agency and the AFMMD assigned Space Technology Laboratories the responsibility for the project which was carried

out under the overall direction of the National Aeronautics and Space Agency. One measure of this

teamwork is the spectacular success of the Able One flight into outer space.



1st stage, Able One Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical. Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical. Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical.

2nd stage, Able One Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical. Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical.

3rd stage, Able One Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical. Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical.

Payload, Able One Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical. Gyroscopes, Barometers, accelerometers, electronic, radio, control, electrical and mechanical.

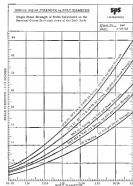
Space Technology Laboratories, Inc. 5750 Wilshire Blvd., Los Angeles 45, California

Space Technology Laboratories, Inc.

5750 Wilshire Blvd., Los Angeles 45, California



New SPS shear bolts and companion locknuts are the strongest shear fasteners ever offered the aircraft industry, point significant reductions in size and weight of threaded joints. Three different strength configurations are available, any one of which will reduce your 50% of ultimate fastener strength. With SPS convertible to 100%.



Greater shear strength. Graph shows shear strength in pounds for various diameter sizes of different shear bolts. Top two curves plot the new SPS super high strength shear bolts available at 132,000 and 156,000 psi stress. Remaining curves represent current aircraft industry standards.

New SPS super high strength shear fasteners save you 25-50% in shear bolt weight

132,000 and 156,000 psi bolts are strongest standard shear fasteners ever offered

These new SPS shear bolts are 39 to 64% stronger than the best standard shear fasteners now in use. They automatically save you 25 to 50% in shear bolt weight, because they can be substituted for conventional fasteners one to two diameter sizes larger...with no compromise in reliability.

For example, one of the new 5/8 in. diameter, 156,000 psi shear bolts, capable of design loading of 39,000 lb., does the structural job of a 3/4 in. NAS type weighing nearly 30% more. On a large airplane this can mean a saving of several hundred pounds. Further, the use of smaller fasteners often permits miniaturization of joined parts in a joint, resulting in additional weight savings.

The new bolts are forged from 5% chrome high strength steel, then heat treated to 220,000 psi tensile for the 132,000 psi shear series and to 260,000 psi tensile for the 156,000 psi. Both series are available in standard sizes #10-32 through 3/8-18, with companion locknuts of new design. The 132,000 psi shear bolts have a cadmium-fluorocarbon plating, the 156,000 are vacuum cadmium plated. For complete information, write Aeroall/Miles Division, STANDARD FUSED STEEL CO., JENKINTOWN 3, Pa.

HIGH RELIABILITY

SPS research is constantly developing fasteners with higher standards of predictable performance. By installing SPS high-reliability fasteners in your assemblies, you increase overall product reliability.

For more information on the full meaning of reliability, write for a copy of the new SPS booklet "High Reliability."

We also sell these products in Division's Southwest  and the International

SPS

JenKintown • Pennsylvania

Standard Fused Steel Co. • The Cleveland Co. Steel Co. •
Cleveland Steel Structures Co. • Aeroall/Miles Division, Inc.
• Steel Sales Co. • SPS Products • Canada: Canadian Steel, Inc.
• British: British Steel Sales Co., Ltd.



CLAY PIGEONS

low-cost, supersonic target drones

Clay pigeons that fly faster than sound—that's a matched description of the new low-cost target drones developed by Bendix Systems Division.

Program-controlled (with radio override, if desired) they will provide the answer to our need for airborne target drones which can be built in quantity and at a moderate cost. They are ideal vehicles for testing the effectiveness of our new aerial weapon systems, as well as the skill and training of the men who fly or launch them.

The basic design, developed over a two-year period (at as fast as the American taxpayer), is relatively small and light, which accounts in part for its low cost, and carries radar and infrared augmentation equipment which enables it to realistically simulate a much larger target if desired.

It can operate at all required altitudes, speeds and ranges.

Bendix target drones make small diameter, and hence low cost, by means of the Bendix Lens, a small photo sphere for enhanced latitude, as well as monostatic radar reflectors. Also included are Bendix electronic steering devices for a true distance indication. Components and airborne tests are continuing in conjunction with the Armed Services.

Bendix Systems Division, working with six other Bendix Divisions and major aircraft and production organizations, directed all phases of development work up to and including prototype construction and testing.

Bendix Systems Division welcomes inquiries and is prepared to provide full information to the Armed Forces.

Bendix Systems Division

AIR AND SPACE DIVISION



Voice of defense in the North



Philco Microwave supports Nike control network across Alaska

Unfettered by the most severe winter storms — unhampered by rugged terrain — unopposed in electronic jamming.

Philco Microwave has been selected by the U.S. Army Signal Office to link Nike units in the Alaskan Defense perimeter.

Advanced Philco CLR-9 microwave equipment links extremely reliable electronic communication between these isolated guided missile outposts. Because it provides a completely reliable, uninterrupted communications system in this frozen land, Philco Microwave has become America's "voice of defense in the North."

At Philco, the world of tomorrow is now. To meet the challenge of advanced electronics research and engineering, Philco is pioneering advanced communications systems such as the developed for the Alaskan Nike units. And, at Philco, engineering opportunities are also expanding.

ing—in the development of advanced communications systems, weapons systems and data processing.

Wherever you look at Philco, in guided missiles, in advanced navigation, in infra-red and radar technologies, as well as in communications systems — being "out front" is a habit.

In the wonder world of advanced electronics, look to the leader. Look ahead — and you'll choose Philco.

PHILCO

GOVERNMENT & INDUSTRIAL DIVISION

4750 Woodchuck Ave., Philadelphia 44, Penna.

...speaking of Missile Ground Support **EQUIPMENT**



Here where the most advanced systems and systems are being developed for launch of Nike.

WE PROVIDE PROPELLANT HANDLING SYSTEMS

FMC is one of the few companies in this country that is capable of offering coordinated mechanical and chemical experience combined with design, engineering and production facilities devoted exclusively to building advanced missile ground support equipment, under single responsibility.

Under a contract with Boeing, for example, FMC's Ordnance Division conceived, designed, engineered and built this complete support system for the long-range Bomarc intercepter missile.

Technical assistance on this important defense project was provided by FMC's Westvaco Chlor-Alkali Division. This chemical group is experienced in producing missile propellants such as Dinitrogen tetroxide (asymmetrical dimethylhydrazine) one of the propellants used in the Bomarc.

In the design and production of defense material, FMC's background extends over more than 17 years. Also, FMC has long been recognized as a leader in the chemical field. This broad experience, supported by Ordnance Division's completely integrated facilities devoted exclusively to the manufacture of military equipment, can be applied to your missile project—from design concept through development, engineering and production, to on-schedule delivery.

For any size missile ground support project—fixed or mobile, consult with FMC at the concept stage of planning. Contact us today for more information.

Create Experiences. Find stimulating challenges at FMC's Ordnance Division.



FOOD MACHINERY AND CHEMICAL CORPORATION
Ordnance Division

Main Equipment Section 35

1965 GOLDMAN AVENUE, SAN JOSE, CALIF.





In Research—meet three men who get results

From high notes to high altitudes, harmony is the keynote of General Mills Research

Meet this harmonious trio of research scientists who spearhead progress in space technology at the Mechanical Division of General Mills. At the piano is Dr. Omer Saxton, whose primary fields are physics and electronics research. Directly opposite him is Les Demont, manager of aerodynamics and aerospace research. Sam Jones, standing to the left of the piano, is in charge of the section devoted to materials and mechanics research.

Scientists in our Research Department, like these three, help lay the groundwork for man's conquest of space. They work in harmony with each other and with the creative engineers and precision craftsmen who apply their findings.

Perhaps you can profit from research like this. We'd like to work with you. **NEW! BOOKLET RIGHT OFF THE PRESS** tells and shows the many ways we serve industry and the military. Write for your copy. Address Dept. AA-2



Dr. Saxton, Mr. Jones, Mr. Demont work with the electron mirror microscope, a complex instrument which provides a picture of the structural potential distortions on the surface of matter. This microscope was developed by General Mills for research and development work in solid-state and surface physics. It is the only one of its type in the country.

MECHANICAL DIVISION



2020 Corded Avenue • Minneapolis 13, Minnesota

We solve needs—through intensive research • creative engineering • precision manufacturing

A COAXIAL DISCONNECT IN SECONDS!

COAXICON—based new. One stroke of the A-MP precision tool does it. Two strokes and you have the pin and receptacle units permanently attached to coaxial cable. For low level circuitry, either panel mounted or free hanging.

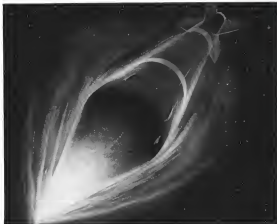
- Reliability—the highest. Cost—lower than anything you're now using.
- Further, coaxial cable is fully supported against vibration.
- All this in seconds . . . no more burned insulation . . . no more tedious soldering . . . no more doubtful connections. Attachments at unbelievable speed that give you the fastest termination at the lowest total installed cost.

Write for more information today.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering standards are available through subsidiary companies in: Canada • England • France • Holland • Japan



Optimized working temperatures up to 400°F are in good measure. But despite its proven mechanical resistance and heat resistance, CDF glass base laminates of Teflon™, the only laminates in their class equipped by the industry with the patented slitting.

LATEST HIGH-HEAT INSULATION SYSTEMS NEED CDF GLASS-BASE LAMINATES AND TAPES

Widest available range offers Teflon, epoxy, silicone, mica products for dimensional stability under continuous heat

As components and equipment grow smaller, and heat becomes more difficult to dissipate, CDF high-heat electrical insulations become increasingly important to electronic designs. For nowhere else can you find a wide range of quality insulations be found under one roof as at CDF.

FOR HIGH-HEAT PRINTED CIRCUITRY, CDF glass-base Du-Clad® laminates of Teflon® and epoxy exhibit heat dissipation stability and constant-capacity capacity. Constant operating temperatures of 300°F—soldering temperatures to 500°F—are readily met by these specialized CDF Du-Clad laminates.

HIGH-HEAT FLEXIBLE INSULATIONS. CDF offers a wide choice of insulating tapes made of Teflon, silicone varnish, silicone rubber, and MicaBond®, with glass-kloth support. CDF tapes may be used either by hand

wrapping or on automatic winding machines. Unsupported Teflon is often available to meet MIL-STD 104.

TEFLON SPAGHETTI TUNING AND OTHER SPECIALTIES. Part of CDF's vast fabrication facilities is devoted to the production of custom parts from Teflon—spaghetti tubing, rods, sheets, and machined parts to rigid specifications.

NEW—removable Teflon, bondable to steel and to other materials with commercial adhesives.

SEE SWEET'S Product Design File, Electronics Buyer's Guide, and other directories for the name and phone number of your CDF sales engineer. Then send your price or your problem, and we'll recommend the proper material for the application.

No advertising or editorial fee for business reply card design



CONTINENTAL-DIAMOND FIBRE
A DIVISION OF THE HUBBARD COMPANY • NEWARK 10, DEL.

SOLVING PROBLEMS COMES EASY WITH SAGINAW b/b SCREWS!

- EXCESSIVE POWER CONSUMPTION
- SPACE/WEIGHT PROBLEMS
- TEMPERATURE EXTREMES
- PRECISE POSITIONING
- LUBRICATION
- DEPENDABILITY



THE INVENTIVE b/b SCREW

Used where efficient production/control and dependability is essential in manufacturing and guidance systems, our unique coupling bearing, and shafts deliver unique mounting applications.

THE SAGINAW b/b SCREW

Used in automatic assembly, precise positioning, as speed limiter, etc., in stamping machines for precise location, and many other applications.

ACTUATE AND POSITION WITH OVER 90% EFFICIENCY... 4/5 LESS TORQUE!



NO TIGHTENING. When every screw is tight, no tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.



NO TIGHTENING. When every screw is tight, no tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.

- 1. NO TIGHTENING NEEDED.** No tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.
- 2. NO TIGHTENING NEEDED.** No tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.
- 3. NO TIGHTENING NEEDED.** No tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.
- 4. NO TIGHTENING NEEDED.** No tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.
- 5. NO TIGHTENING NEEDED.** No tightening is needed. The b/b self-gripping ring, the ball of the screw, and the ball's gripping action keep the screw from loosening under vibration.

SEND TODAY FOR FREE 1969 ENGINEERING DATA BOOK... or see our section in Sweet's Product Design File

Available in custom machine ground and stock rolled thread types. Also forms been built from 1/16 inches to 2 1/2 inches in diameter.

Saginaw b/b bearing screws and Splines
SAGINAW STEELING CO. DIVISION OF GENERAL MOTORS • LANSING, MICHIGAN
MOTOR'S LARGEST PRODUCER OF BALL BEARING SCREWS AND SPLINES


B·O·A·C orders

DECCA/DECTRA

for the

North Atlantic
COMET
 fleet

The only navigation system which enables lateral separation to be exploited — a necessity for the efficient operation of jet aircraft

THE DECCA NAVIGATOR COMPANY LTD LONDON ENGLAND

U.S. Licensees: *Decca Radio*



**CENTURY PRESSURE SWITCHES
 PERFORM WITH CONSTANT
 REPEATABLE ACCURACY**

Anywhere



Gage — Absolute — Altitude or Differential Types

There is a Century Pressure Switch for Your Application



**NEW CATALOG
 NOW READY**

MARINE
 SERVICES

AIRCRAFT

MISSILES

AUTOMATED
 FACTORY

NUCLEAR
 INSTALLATIONS

**CENTURY ELECTRONICS
 & INSTRUMENTS, INC.**
 1251 N. UTICA • TULSA, OKLAHOMA



B. F. Goodrich Unilock Rivnuts® designed especially for aircraft and missiles

*New lightweight steel Rivnuts with thread-locking feature
preserve structural strength... save assembly time and costs*

Ordinary anchor type fasteners used in aircraft and missiles require as many as three holes. And installation is made by two men who must have access to both sides of the work.

But new B. F. Goodrich Unilock Rivnuts can be installed by one man from one side of the work. Only one hole is needed. And the job can be done at any time during or after assembly.

This greater flexibility in manufacturing procedure means a substantial savings in cost. In addition, with only one hole required instead of three, greater structural strength is maintained.

B. F. Goodrich Unilock Rivnuts, in fact, actually reinforce holes. That's because the specially spaced V-ribs under the Rivnut heads lock the Rivnuts in the

material in which they are installed. This eliminates the need for a key and keyway—features which ordinarily set up points of stress concentration.

The thread-locking feature is a direct result of the shape of B. F. Goodrich Unilock Rivnuts. This provides crushing action with an all metal fastener so that loads themselves are in place.

Made from aircraft quality alloy steel, B. F. Goodrich Unilock Rivnuts are actually heavier than most anchor type fasteners. Yet they will meet strength and torque requirements of Military specification MIL N 25027 for lock-type nuts.

B. F. Goodrich engineers will be happy to make recommendations concerning the use of Unilock Rivnuts in your products. For complete information write B. F. Goodrich Aircraft Products, a division of The B. F. Goodrich Company, Dept. A197, 29 Akron, Ohio.



B. F. Goodrich Unilock Rivnuts are basically the same as ordinary nuts and function as regular type Rivnuts. However, the Unilock design is illustrated by the V-rib under the head and the cross-hatched design which provides the thread-locking torque which sheds the top of the hole, thereby reducing grip range.



Specially spaced V-ribs, made as an integral part of the outer side of the head, engage with surface of material in which the Rivnut is installed thus providing high torque resistance and eliminating need for key and keyway.



Typical Unilock Rivnut installation in blind application. Installation principle is same as for regular Rivnuts.

B.F. Goodrich aviation products

EDITORIAL

The Cost of False Economy

The crash of an American Airlines Electra turboprop transport in the East River off LaGuardia Field last week is another prime example of how the doctrine of false economy can prove terrible, expensive in human life and property when attacked by government officials who understand little of the genuine problems of aviation and its related technologies.

The Electra accident destroyed 85 lives, and washed out a \$2 million aircraft.

President Eisenhower, in his Washington Post conference held the day of the crash and just before he took off for Thessalonika, Ga., for some golf and bridge playing with former Secretary of the Treasury George H. Brown, and his friends, had the following comments to make regarding the crash: he advocated a federal report and the serious modernization program.

"Now in the airport heli, the airport heli of the Administration directly said to me before and one factor only improving the safety of flying whether it is in the air, taken on when you are arriving. It is not irrelevant and does not prevent itself in building a new level administration building and the things we would do for the airlines, these depths. The federal government did not build the terminals for either the airlines in the future. I see no reason for doing it for the air terminal."

"But this matter of which is very, very important, emphasizing again the accident this morning. 'New Gas, Quacoda' (Federal Aviation Agency, administrator) where no there is no evidence that any failure of the airway system, safety system had anything to do with this particular accident. No means put into the building of the terminal, the building, administrative buildings or other conveniences could have helped in a place that kind of accident. There are all sorts of places where this money is not needed but it needed for improved flying safety and that is what I believe we should do."

We agree with the President that financing terminal buildings should be a local responsibility, rather than a federal quest. And, of course, everybody knows that inner terminal buildings will not improve air safety except perhaps by providing a clear, well aligned place for pilots to sort between flights.

It is still too early to tell exactly what caused the final fatal moment of the LaGuardia-bound Electra, but it is obvious that the accident occurred in an area that has been a safety zone for more than five years and that no corrective action has yet been taken because of the combination of slow moving, equipment because race and penny pinching on the federal aviation budget. As long ago as December, 1955, Capt. B. C. Robinson of American Airlines wrote a series of columns in *American Voice* entitled "Runway Night Over New York," in which he detailed the safety hazards presented to air line traffic by the lack of sufficient electronic landing aids and high intensity approach lights at LaGuardia Field (it even really had weather).

It is worthlessly going back and heading that series in

the Dec. 12, 19 and 26 issues of December, 1955, Capt. Robinson describes in detail his own experiences with the difficulty of making a back course ILS approach without the benefit of glide path. He also has written many columns on the gross inadequacy of the high intensity approach light program and the building diagrams that contained a pilot backing out of cloud into a black hole of land or water and trying vainly to catch a quick glimpse of the runway threshold to align his landing properly. With the advent of larger, high speed gas turbine powered aircraft, this problem becomes increasingly acute as the time available for action diminishes and the response of the aircraft is slower.

Complicated, penny-pinched bureaucracy of the now defunct Civil Aeronautics Administration allowed the LaGuardia instrumented approach situation to fester for several years after Capt. Robinson described it in detail from the vantage point of his Cessna/Boeing cockpit. Not until 1957, when James Pyle was CAA administrator, did the program for dual ILS installation at LaGuardia and several other key air traffic hubs get sufficiently vigorous push to handle the current issue and become a part of the federal aviation modernization budget.

The second ILS installation would cost about \$20,000 and will not be installed until later this year. So far, a set of modern high intensity approach lights for this same runway would cost \$120,000. Apparently, objections from the shipping interests have combined with economy to keep this item from the federal aviation budget because it is not there yet.

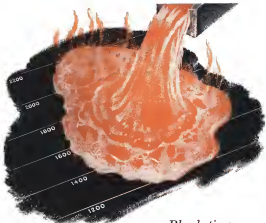
Now, making an instrument approach down the back course of the ILS system with only a direction finding available and no glide path to give a safe altitude approach to the runway and bring to attention a small reference against black water is a new high-speed aircraft were certainly major contributions to this Electra accident. If these turn landing aids had been available, the chance as strong that no such accident would have occurred.

In the light of this past penny-pinching economy on federal aviation safety aids, it is hard to evaluate the President's statement and the \$53 million cost already reported in the Fiscal 1960 savings budget with the one placid assurance that "efforts are not being building into the purchase of equipment that has not yet been initiated in meeting long term needs."

Question is one of the major causes of failure and, in this light, it is obvious that the federal aviation system assembly behind the crash of American Airlines Flight 120 when they and their passengers needed it most. We think Mr. Quacoda has done the President and the American air traveling public a grave disservice in trying to make the responsibility of penny pinching an safety policies in the LaGuardia Electra crash.

It would have served a far more useful purpose if he had given these unsolicited facts to the President and pushed harder for a truly adequate modern air safety program.

—Robert Foltz



Blanketing the high temperature field



Cone coated is assessed over every step in the production of Haynes alloys. This sleeve is furnace in part of the modern hot up methods in Haynes facilities.

A fairly substantial claim! Yet we can prove that HAYNES alloys do exactly that—all the way up to 2000+ deg. F. Here's why: There are 12 Haynes high-temperature alloys. Among them you will find the right combination of properties to handle any heat condition. For example, HAYNES alloy X has remarkable resistance to oxidation up to 2200 deg. F. HAYNES alloy No. 23 is strong and resists stress, oxidation, and carburization up to 2000 deg. F. HAYNES alloy R-335 is outstanding in the 1500 to 1750 deg. F. range. And this is only part of the story. All 12 Haynes alloys are production alloys and are readily available. Some of them are vacuum melted, some are melted, some are cast, some wrought, and some are produced in both forms. For the full story, write for literature.

HAYNES
ALLOYS
HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Edison, Indiana



The words "Haynes," "Stellite," and "Union Carbide" are registered trademarks of Union Carbide Corporation.

Washington Roundup

Capsule Recovery?

Sovets have received an instrument loaded space capsule after three in orbitations around the earth as a satellite, according to unconfirmed reports reaching West Germany from the Soviet Union. According to this as yet unverified claim, the Soviets launched the instrumented satellite early February in a test for recovering space capsules. The glider capsule was coated with a wooden plane type ablative material similar to that used in the U. S. Army's lighter test case.

Total capsule weight was about 100 lb. Ablation material failed to protect the chamber sufficiently during ascent, and instrumentation was reportedly badly damaged on recovery. According to the reports reaching here, the capsule made three orbits of the earth of approximately 107 min. It was then directed to re-enter the atmosphere and impact within the Soviet Union.

Atlas Potential

T. G. Langley, Jr., vice president and assistant to the president of General Dynamics Aircraft Division Corp., says Convair and other firms associated with the program has positive future as Atlas intercontinental ballistic missiles "as we currently going to be asked to be 1961."

In a discussion of the Administration's apparent decision not to buy and modify the Soviet Union in the RBM field (see page 26), Langley was asked by *ENR* whether on the National Broadcasting Co.'s "Today" television program if he were content to let this happen. Langley replied:

"No, I'm afraid not. I don't think our thinking was should be... if we have enough of them (Atlases) to make and of the right quality to meet that threat, I wouldn't be concerned, but I'm afraid at the moment the government isn't asking for enough of them and we're going to have them in time."

Commenting upon industry's ability to produce the Atlas and catch the Soviet effort, Langley said "The government, of course has to ask for the material and has to ask for more in time."

ARPA's Future

Under present Defense Department planning, the Advanced Research Projects Agency will become a fourth operating agency along with the Air Force, Army, and Navy, Oklahoma Senator Carl Albert said. He said the House Armed Services Committee last week. Research and engineering programs of all time will be supported and coordinated in the Office of Defense Research and Engineering headed by Dr. Herbert York. McNelly added that the office of director of guided missiles to evaluate will be eliminated.

Veto Hinted . . .

President Eisenhower implied that he will veto any legislation to support the building administration buildings. He said he will veto any legislation to support the building administration buildings. He said he will veto any legislation to support the building administration buildings.

McNelly's statement on the subject was a rebuke to the Administration's position that the Administration is interested only in providing funds that will support progress in the industry.

of flight and not in building administration buildings. He said he will veto any legislation to support the building administration buildings. He said he will veto any legislation to support the building administration buildings.

The President added that the Administration has helped substantially in the past by putting money into 40 projects "of which last year there was less than an average of 10 planes returned."

The Senate bill calls for a five-year \$505 million aid program that would provide \$100 million annually for the construction of missiles and other facilities. The bill is in sharp contrast to the President's budget plan for an "orderly withdrawal" from the current grant program during the next four years.

. . . But Democrats Admont

Meanwhile, Majority Leader Sen. Lyndon Johnson (D-Tex.) promised quick flow action, even if it means cutting eight unions, as the Senate Commerce Committee bill. The measure provides \$100 million a year plus \$45 million for airport construction for the next five years plus \$45 million for airport construction for the next five years plus \$45 million for airport construction for the next five years.

Commerce vote on the proposed legislation followed party lines, as expected. Republican committee members supported a continuation of the present level of \$50 million a year for five years for a total of \$250 million authorization. Edward Gurnea, Federal Aviation Agency administrator, has urged that the program be cut back to a total of \$200 million spread over the four years.

Vanguard: Long Life

Dispositive Vanguard I satellite got a jet on the back and a production of an extremely long life test from the Naval Research and Development Board. The satellite is now in orbit.

Harvard said the 6-in., 115-lb. sphere was launched to orbit for 2,000 yr. Longest previous estimate was about 200 yr. Vanguard I is the only U. S. object in space that is still functioning. The jet is designed by "the most well-known satellite in the fact that the satellite's solar power is solar batteries, it will function. Other U. S. satellites either have failed or their radio have failed. Vanguard launchings are scheduled to begin again in less than two weeks under National Aeronautics and Space Administration direction. Next satellite will carry a 25 in. neither more expensive satellite. Four vehicles remain in the program.

Schedule Reliability

Reliability of airline schedules will officially be available for public release at beginning May 1 by action of the Civil Aeronautics Board. Board members will bring the "reliability" of past airline schedules and lack of evidence that the situation is improving, voted to adopt a new system of relative schedule reporting. For a six-year period, carriers must file reports of the total number of flight delays, including enroute and late arrivals of five to 30 min. The code system will show that the reports, filed within 45 days after the close of each month, would be a source of public record available for comparison and analysis. The Board had also in the interim members of the public, including competing airlines.

—Washington Staff

Defense Officials Concede Missile Lag

Administration witnesses admit to Soviet space, missile lead, defend hold-the-line budget plan.

By Fred Eastman

Washington—Administration witnesses admitted to Congress last week that the Soviet Union is ahead of the U. S. in its space and ballistic missile programs but contended that no congressional program was warranted that would jeopardize national interests.

The officials testified, almost unanimously, that, while the U. S. lags in certain aspects of its space and missile programs, it leads in others and that, on an "overall" basis, adequate funds are being provided to meet the nation's defense requirements.

This has been the general theme of testimony by witnesses appearing at hearings of the Senate Subcommittee on Astronautics and Space Sciences, and House Committees on Science and Astronautics, Defense Appropriations and Armed Services in support of President Eisenhower's hold-the-line defense budget for fiscal 1960.

Democratic members of these committees had built up charges that the president's new "maximum and no loading" and made in an effort to justify "irresponsible defense budget."

After nearly two weeks of hearings to members this is how Administration witnesses said the U. S. and Russia in the space and missile fields:

- **In space exploration,** it was generally accepted that it will take the U. S. from 15 months to two years to reach the moon, while Russia is actually in parked sub-orbitations sent into space.

- **U. S. is behind in the uncontested ballistic missile field** but the rate of the gap is widely disputed. It is has been estimated that the Russians achieve gains in numbers will range all the way from four to one within three years to "one in two" missiles at the end of this year.

- **U. S. is in the superior in quantity and quality of manned bombers and other aircraft and maintains sufficient air-to-air strength to deter a potential crisis from launching a general war.**

The witnesses, led by Defense Secretary Neil McMillen, took the usual to testify that the Administration has fiscal 1960 defense budget provides sufficient funds to carry on a "well balanced program that will meet the country's defense requirements."

In prepared statements and in re-

sponse to only questions, the witnesses maintained that the budget adequately met that additional funds would not necessarily accelerate the programs. In addition, McMillen presented a letter from the Joint Chiefs of Staff stating that they considered the proposed acceleration figure for fiscal 1960 adequate to provide the essential programs necessary for the defense of the nation.

However, in response to later questions asked by committee members, staff, Defense Department, a witness admitted that they had asked for more money for certain programs than the Administration has asked Congress to provide and that the officials are aware of the amount of "extra" money. McMillen, Arthur A. Borman, Chief of Naval Operations, told the Senate Subcommittee that he had requested a Navy budget of \$13.5 billion last fiscal year but got 52.5 billion to \$13.5 billion. As a result, he had more Navy programs, including the Navy's first ballistic missile system, had to be downgraded.

Adm. Borman said his major concern

is over the material qualities of the fleet, of which 51% are constructed in World War II. He added that the fiscal 1960 budget would permit only resupply of only 2% of the fleet which would be inadequate each year. He also said he was severely concerned over the limited funds provided for replacement of aircraft ships and aircraft.

Gen. Thomas D. White, Air Force Chief of Staff, reported that the Air Force had \$20.6 billion for fiscal 1960 but was allowed \$18.6 billion. He said his chief concern is that three fourths of the Strategic Air Command, which controls the nation's primary deterrent, is approaching obsolescence and that more emphasis should be placed on procuring new modern weapons systems.

Gen. William A. Tamm, Army Chief of Staff, said the Army would require \$13.5 billion in fiscal 1960 in order to maintain its required strength and was allowed only \$9.9 billion. As a result, he said the Army is forced to cut back all its surface-to-air missile programs.

• **Ray W. Johnson,** director of the Advanced Research Projects Agency, told the committee his budget request had been cut 20% and that such a would be rapid development of the missile business and its improvement of missile and missile tracking capabilities. Johnson said that, not only should the Defense Department's space program be given more money, but that the National Aeronautics and Space Administration's civilian space program should have a larger budget.

• **William M. Holladay,** Defense Department undersecretary, said that his satisfaction with the balanced spending program, later admitted that his recommendation that two more Polaris submarines be built in 1959 and 1960 had been turned down.

• **Major Gen. Bernard A. Schriener,** Air Force Ballistic Missile Division commander, told committee his expects to produce more ballistic missiles than current planning calls for and that he would like to see a greater buildup of ballistic missile force, including large numbers of intermediate range ballistic missiles to be in service by 1960.

• **Wanderer von Braun,** Army Ballistic Missile Division director, said that he had the Russian may have "hundreds" of ICBMs in development against U. S. bases in Europe and that it would take the U. S. five years to build a missile force to destroy the nation to spend an addi-

tional \$140 million over the next five years on development of the 15 solid-fuel, 16-classes of booster engines being developed by ARMA and said additional money also should be allocated for basic research.

• **Col. Gen. Stewart E. Anderson,** Commandant of the Air Research and Development Command, told the House Space Committee that he had requested \$1.75 billion for fiscal 1960 but had been given \$1.75 billion. As a result, he said, some of ARDC's programing will have to be canceled and that plans to procure improved versions of the Northrop Star, had to be abandoned.

• **Brig. Adm. Robert T. Howard,** Assistant Chief of Naval Operations for research and development, told the House Space Committee that the Administration had cut his research and development budget for fiscal 1960 from \$7.9 million to \$5.52 million.

Adm. Howard said inexperience also has hampered the national space effort and called for a single U. S. Space Agency to handle the national space effort and said the National Aeronautics and Space Administration is following suit, and that the military service, and that, under the circumstances, the U. S. could not be a successful national program.

One of the few astronauts also appeared contentedly introduced with hands budgeted for fiscal 1960 was Keith Glennan, NASA administrator. He told the House Space Committee that he felt his agency was adequately funded at the present but that if he felt more money was needed, he would not hesitate to ask for it.

Glennan said the committee NASA is proceeding with all present projects "with the greatest sense of urgency and under the greatest load at present possible." It would be possible to lose greater amounts of money by spending more money, but all would not necessarily accelerate the nation's progress, he added.

Glennan said NASA, with the Advanced Research Projects Agency, has launched research projects designed to give the U. S. more powerful booster systems as soon as possible. By the summer of 1960, he said, a second stage rocket engine will be available for use with an Atlas that will permit placing a 3,000 lb payload into orbit or send a 1,000 lb payload in to orbit the moon.

Another second stage for the Atlas is under development by General Dynamics of General Dynamics. The solid-fuel liquid-fuel rocket motor being developed by Pratt & Whitney Aircraft Division of United Aircraft. To be completed by 1961, the second stage will, when used with an Atlas or Titan booster, permit placing 75 tons of payload into orbit or sending a 2,000 lb payload to

President Views Soviet ICBM Claims

Washington—President Eisenhower last week dismissed as "unfounded" Soviet reports on the progress of their missile program. The President also sought to allay the concern of the U. S. as to the status of the Soviet Union's missile program. He said that the Soviet Union is not in a position to mount an ICBM program that they are not in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.

"I, as President the Soviet Union," President Eisenhower said, "do not see how the Soviet Union could be in a position to build missiles capable of hitting their targets accurately and precisely. He said the question was the President's reply in the official transcript of the conference.



Two Douglas SM-75 Thor intermediate-range ballistic missiles are in final assembly at Santa Monica, Calif. Nine conventional sections fit in diameter superstructure (foreground), at center. Three reusable attack pods are on forward tips of boosters at right and left. Short bladders ending above booster control and propellant reservoirs find a moment of vertical separation to prevent release from over-taking nose cone. Long bladders on side of each booster are being installed in left Thor.

Douglas SM-75 Thor IRBM in Production

IR-5 main propulsion rockets are on carrying jigs awaiting installation. Aluminum-painted combustion chambers are in center.



Thor tank and ballistics are painted and ground. RF-4 tank is the limit of nozzle and liquid oxygen tank in size are separated by about 2 ft. of structural structure. Fuel line passes through liquid oxygen tank.



One of two Rocketdyne double-guided reentry vehicles is installed on all ballistics of Thor. Verner thrust chamber is of double wall construction and burns the same RF-4 fuel and liquid oxygen as main propulsion system.



Reentry hole is drilled during assembly of the truncated reentry guidance section which is shown completed in background. Unlike fuel and liquid oxygen tank sections, conventional structural structure is used here.



Thor is erected at Vandenberg, Calif., launch complex (AVF Div. 20, p. 46). One astronaut sits in a vehicle just below reentry stage. Four men, one in each control van is responsible for firing two or three missiles.



McDONNELL AIRCRAFT Model 119 transport plane rolls out with four engines Westinghouse J14 turboprops of 1,600 hp. thrust.

McDonnell Rolls Out Model 119 Turbojet

By Craig Lewis

St. Louis—McDonnell Aircraft moved directly into competition for ability to meet business jet work as it rolled out its Model 119 transport plane for flight tests and a program of demonstrations to potential Air Force and commercial customers.

Rolling out of the hangar with four Westinghouse J14 engines, the 119 transport will be flying in sales competition with the Lockheed Jetstar by early summer.

Production version of the McDonnell 119 will use four Pratt & Whitney JT12 engines, as will the production Jetstar. Both of the small utility trans-

ports will be competing for a role as the USAF UCXK and a USAF production contract, as well as for corporate sales designed for Federal Aviation Agency certification, as well as to meet Air Force UCXK specifications. The 119 is 66 ft long, has a wingspan of 57.6 ft and is 23.6 ft high on-cowl. With the JT12, it will have a top cruise speed of 965 mph with maximum continuous power and a speed of 550 mph with maximum cruise power.

Gross weight of the utility transport will vary between 35,000 lb and a top of 45,530 lb, depending on the fuel load. Normal range is still as in 3,015 stat mi with reserves, but extra structural fuel tanks can boost this to 3,000

mi. Maximum cruising altitude is 45,000 ft.

McDonnell has put more than 510 orders into the 119 program so far. The company won't say now whether the aircraft will go into production without an Air Force contract, and no price has been quoted. President James S. McDonnell said "in order to offer an attractive price, we feel we ought to have an Air Force contract," but he refused to give production plans specifics to a contract award.

The 119 program is part of a screen effort to develop, for McDonnell, a transport with 30% of its business in lighter aircraft and it doesn't seem likely that the project will be given any work. Signs of the company's screen intentions can be seen in the establishment of a transport division two months ago. Then new group is headed by Robert E. Hoge, former Boeing project representative on the 707, and he is a McDonnell vice president as well as transport division general manager.

Transport Division

Transport division is currently being organized and built up. A commercial sales staff has been formed, but it is not completely staffed. Some commercial engineers have come on over the past year, but now that the engine will be flying, McDonnell will be launching a Federal sales program. Only one prototype will be built and the first production 119 would come off the line 16-18 months after a decision is made.

Following the precedent set by Douglas, Boeing and Grumman, the 119 has its engines podded under the wings, rather than using the lift fuselage mounting currently popular with the



UPP version is under way in front of new gas duct. Pod-begined clearance will increase 6 in. with Pratt & Whitney JT12.

Utility Plane

smaller turboprop transports. After looking at 14 different configurations, McDonnell decided the 119 layout with pod-begins most practical for a four-engine transport.

Sixty is cited as one advantage, since a modification to one of the squibs pods won't affect the others. Four maintenance men can reach the engines as close to the ground and easy to reach.

Engine Choice

General Electric, the Fairchild J55 engine was chosen for the 119, with the JT12 as backup. When the Air Force withdrew the J55 (AWR 32, p. 33), McDonnell switched to the JT12 for its production engine. First JT12 is expected in September and the engine is scheduled to fly with 340 hp engines in December.

With neither the J55 nor the JT12 available now, McDonnell had to use the Westinghouse J14 as its prototype to meet the first flight schedule. Even for the JT12 will be somewhat smaller than those on the prototype, since this engine is a third the weight and half the size of the J14. Pod to ground clearance will increase about six inches with the JT12 pods.

Engines are placed close enough to the center of gravity that there is considerable latitude in nac and wing, and therefore in engine choice. Pods have taken-over job under the intake to avoid ground object ingestion.

The 119 wing is swept 35 deg at the quarter chord line. It has an area of 550 sq ft and an aspect ratio of 6.0. Small slotted ailerons lateral control, with some help from spoilers on top of the wing. Spoilers also act as air



Wing on the McDonnell 119 is swept 35 deg at the quarter chord line (above). It has an area of 550 sq ft and an aspect ratio of 6.0. VHF section is on top of the 119's cockpit roof (below). Air scoop for the de-icing system is at the root of the dorsal fin.



SMALL slotted ailerons lateral control, with some help from spoilers on top of the wing. Spoilers also act as air brakes. McDonnell Model 119 has Fowler flaps, plus split flaps.

119 Performance With JT12 Engines

	3,500 mi. Range	Normal Range	Poll Range With Feeding Yards
Takeoff gross weight—pounds	16,236	43,921	45,210
Paraglider	50	10	8
Range—miles per hour	1,560	2,051	2,126
Maximum cruise altitude—feet	44,000	46,350	48,000
Critical fuel length—feet	1,914	4,125	1,215
Loading ground (all shaft fuel)	1,500	1,938	1,930
Load speed (1100) ft—knots	98.3	99.6	92.0
Cruise power for maximum range—horse	457	457	475

† Range calculated against a 75 kb bandwidth, 50 ms resolution at one level in bins of 500-C/4001A counts.

brakes. Aircraft has Fowler flaps, plus split flap.

Conventional saddle and fixed vertical 2 in. parallel displacement control, as longitudinal control is provided by cleanness on the trailing edge of a movable horizontal stabilizer. Longitudinal trim is maintained by the movable stabilizer, and directional and lateral trim is accomplished by tabs on the ailerons.

All controls are manually operated, and all primary control surfaces have balance tabs. Wing and tail leading edges are equipped with boat-type de-icers.

Normally, all fuel is carried internally in the wings. Each outboard wing panel forms an integral tank, and a third integral tank is in the center section between the spars. There are also fuel cells in the wing aft of the spar spar. External tanks are provided by putting tanks in the nose and tail sections outside the fuselage pressure zone. This adds about 550 gal to total capacity.

Leading gear, flaps, brakes and spoilers are operated by a 3,000 psi. hydraulic system. The d/c electrical system provides power for navigation and communication equipment and lights and also to inverters which supply a.c. power for windshield deicing and other needs. Training versions of the 119 are expected to have an a.c. electrical system to supply equipment requirements.

line equipment will be used retroactively in the 115 cockpit. Luvion includes a dual NAVCOM computer and communication system, dual ADF-200 automatic direction finder with gyrocompass and dual loops, L-103 autopilot system combined with CIB 300 dual instrument display, driven by VC-100 vertical gyro and DG-100 directional gyro, plus supporting electronic systems.

Cabin of the 179 is pressurized by bleed air from the engines, and an internal altitude of 8,000 ft. can be maintained at 44,000 ft. McDonnell says the business jet will set the

sign with wide use of a single load path to produce structural safety. Rafts are 20 m apart, and stringers are six inches apart, and each stepping design looks cracks at the first piece of stru-

Normal passenger load for the 119 is 10, although up to 26 passengers can be carried in a high density seating configuration. A number of case-control studies have shown that passengers on congestive aircraft are at greater risk of contracting SARS, as suggested by McDonald. The 59-ft diameter of the cabin permits a flat floor with a 74-in. ceiling height, and a floor and ceiling layout allows a variety of seat and aisle layouts, as well as providing clearance for heavy bags. The 119 can carry 8,700 lb of cargo.

McDonald estimates that operating cost per mile of the 119 is in the same area as comparable turboprops and just below piston engine transports.

Self-insurance is designed into the 119 as an operating feature. The aircraft has an integral stair and self-se-

119 Dimensional Data

Body	
Spine, maximum	37 ft 7.2 in
Area	518.0 sq. ft
Swampback at 25% chord	15 deg
Aspect ratio	6.9
Tail	
Horizontal	
Span	21 ft 2 in.
Area	119.0 sq. ft
Swampback 25% chord	15 deg
Aspect ratio	4.5
Vertical	
Span	145.3 in
Area	90.0 sq. ft
Swampback 25% chord	45 deg
Aspect ratio	1.7
Height and vertical cut	
Length, maximum	23 ft 7.7 in
Length, maximum	46 ft 5.9 in
Wing of main blade	119.0 in
Wheel base	247.9 in
Parallelogram diameter	58 in
Cabin height	74 in

based starting point. No stands are required for engine, wheel, or normal field rotation.

Along with the usual utility functions of personnel and cargo transport and evacuation, McDonnell's customers made applications for the 119 as trainer and a check aircraft for weapons facilities.

Among training possibilities are configurations for borderline navigators, electronic countermeasures operators, intercept radar operators and for basic aviological training. McDonnell expects to be able to get limited types of radar equipment in the 1970s more in order to make training more realistic, and the company points out that training in the ability aspect would be cheaper than using combat aircraft.

News Digest

Hercules Powder Co. and Stauffer Chemical Co. will jointly form a new company to produce aluminum alkyls, including methyl aluminum. Materials are of interest as phosphorus-nitrogen fuels (AW Mar 11, p 24 Oct 27, p 84) and as high altitude flame extenders in turbojet engines. Capacity of proposed plant will be in excess of 1 million lb/year.

Thomas S. Gates, Jr., Secretary of the Navy for the past two years, will resign on June 1 to return to private business. Gates, who has served in the Navy Department for a total of six years, will be succeeded by Navy Undersecretary W. J. Louis B. Franklin. Franklin, a 64-year-old New York accountant, first joined the government in 1951 as a special assistant to the Secretary of Defense.

Twentieth USAF-Casualty Atlas notes: "successful bulge" made was first successful, over a programmed range of more 4,000 feet in lower Cape Canaveral, Fla. last week. After launch, range began in June of 1957. Three flights have been closed as successful but as portable successful and two as failures.

Boeing Airplane Co.'s Project Star—solid fuel rocket system for probing space and for re-entry problems (AW Dec. 1, p. 51)—has progressed through initial design stages but is not presently scheduled for construction or production.

Canadian 540 turboprop transport made its maiden flight at Montreal, Canada last week. Two engine plane, a modified Convair 440 fuselage with Napier Eland engines (AV Feb 2, p 45), flew for 1 hr with William Langham, chief test pilot, at the controls. RCAF has ordered 10.

Jack Frey, 56, president of Tru-



Two rugged EEMCO rotary actuators power the unique cargo handling equipment on the Lockheed Electra



SIMON rubber substrate Type
 01111 powered by an integral
 200 volt 400 cycle 3 phase AC
 motor at 85 MP will lift and lower
 and load/unload fiberglass cargo bins
 and more. 115 lbs. 4 1/2" x 10" x 10"



Thirty-five more to be delivered jet-powered Eicher flagships for American Airlines will be equipped with new and unique, highly efficient cargo and baggage handling equipment that will enable ground crews to completely unload or reload the aircraft in 4 minutes! In time assemblies for this brilliant new version of the jet age will therefore be revised. Both the Tancor® produced portable cargo hoist and the Lockheed designed internal cargo conveyor system are powered by LIMCO rotary actuators for maximum reliability.

TIMCO heavy-duty roller Type 8 TOW operates the loadboard equipped conveyor system in the belly cargo compartments of American Airlines' Electra-Flapjack. Operated either electrically or manually, the action bar will move the loaded cargo bins forward or aft or hold them in any

designed place to speed up loading and unloading of cargo and baggage at terminals or en route. This actuator resembles an oil-lubricated fully 200-watt 400-cyclic, 3-phase AC motor with integral gear train designed for normal operating load of 130 to 150 lb. In torque at 18 rpm, 14 amps. Maximum static load without permanent deformation is 5200 lb. The actuator is electrically reversible and includes an AC speeded brake. Thermal overload protection, manual drive input shaft and reverse torque lock mechanism.

Reliability of operation was a prime factor in the specification of these actuators by SANCOR and LORONGHE. EIMCO products were specified because EIMCO is a specialist in the design and production of such precision-built actuators and motors. For 17 years prime contractors in the civil and military aircraft and missile industry, as well as their subcontractors, have relied on the experience of EIMCO in this specialized field. Your money is insured.

^aSource: Descriptive statistics of The English Experiment.



ELECTRICAL ENGINEERING & MANUFACTURING CORR

AM12 West Jefferson Boulevard, Los Angeles 16, California - Telephone: BR 6-6111

DESIGNERS AND PRODUCERS OF HIGH PRECISION MOTORS, ACTUATORS, AND RELATED EQUIPMENT... EXCLUSIVELY

Proved in
supersonic

FLIGHT



**PARTS LIKE THESE MACHINED
FROM FULLY HEAT-TREATED
STRESS-FREE BLANKS FORGED
BY CSI IN 705 ALLOY**

After the results of all the tests are in, after all the engineering data are carefully the test test of a metal is will be come... is performance.

And what better proof of a metal's enduring strength than successful performance under the critical stresses of supersonic flight. That's the secret of 705 Alloy forgings produced by CSI.

CSI has developed special techniques for the production of fully heat-treated stress-free forged blanks in 705 Alloy (Federal Specification QQ-A-367.0) — the highest strength wrought aluminum alloy in production use. Its extremely unusual strength members and components, where failure could be disastrous, the advantage for engineers here of the forgings. Distortion during machining is virtually eliminated. Service life is long—and predictable!

CSI can supply stress-free 705 forged blanks in cross-sectional sizes up to 176 sq. in. and lengths up to 7 ft.

Write today for complete information.

**CANADIAN
STEEL IMPROVEMENT
LIMITED**

2889 Hornes Avenue, Toronto
In U.S.: C. P. Russell Co. Inc., Bay Shore, New York

World Airlines from 1954 until his resignation in 1947, was fatally injured last week in a Tucson, Ariz., automobile accident. First a veteran pilot because personnel of General Aviation and Flight Corp. after leaving TWA. Later, he organized and headed the First Corp. design of the F1 Series passenger-cargo aircraft.

Rand Corp. will sponsor its Second Electronic Construction Symposium dealing with problems of latest engineering underground facilities installations at its Santa Monica, Calif., headquarters Mar. 24-26. Subjects will include weapons effects, site selection, protection of exposed areas, communication problems, entry and shock waves in soil, tunnel shapes and water drops of underground facilities and new construction methods and equipment. Persons wishing to attend should contact symposium chairman J. J. O'Rourke at the Rand Corp., 1500 Main St., Santa Monica.

Pan American World Airways and the Air Line Pilots Assn. signed an 18-month contract last week covering pilot pay on the company's new Boeing-707 jetliner transports. Provisions in the new employment issue are similar to those recently agreed upon by American Airlines and its pilots. The American pilots will cover a 14-month flight crew, pilot, copilot, pilot-in-command and flight engineer. Basic international revenue per passenger could mean the carrier's transatlantic jet pilots as much as \$34,000 a year. Signing closeded 18 months of negotiations between the airline and union and opens the way for line pilots to begin immediate jet training. Pan American has been flying its 707's since Oct. 25 using experienced pilots.

National Academy of Sciences-National Research Council has formed an Armed Forces-NRC committee on Bio-robotics that eventually will consist of more than 300 members. The study has been named by the executive council. Committee will serve as a focus of active investigations, exchanging information and establishing liaison between scientists and the various civil and biological aspects of space exploration. One aim apparently is to better acquaint scientists, engineers with military requirements and problems of manned space operations. Committee is supported by a contract between Air Force and the Academy.

Follow-on order of 85 missiles for the newly ordered speed driver for Douglas A-10 Thunderbolt II has been ordered by Air Force's Air Force Department of General Electric Co.



Titan Launch Attempt Fails

Second attempt to launch the USAF's Titan II also uncrewed, infinite missile on its first launch attempt last night from Cape Canaveral, Fla., failed when test work. Automatic systems that detect the first-stage propellant after 1 sec of burning time, using the vehicle. Since it was not detected, there was a possibility that it would be scheduled for launching later test work. Made in the same one with which the first launch attempt was made Dec. 20. It had been sent back to the Mater plant at Downey the repair of a badly liquid oxygen line and then returned to the Air Force Missile Test Center. The first flight will be programmed for less than 20 sec, probably to test first stage propellant, pressure and structural strength. Missile will carry a dummy second stage.

Crash Mars Beginning of U.S. Jet Age

Re Robert L. Stanfield4

Reason for the crash is still unknown. Last contact with the Electra was when the pilot acknowledged clearance to descend, but had approach from his

Anaconda, N 610133, carrying 65 passengers and a crew of six, left Chicago at a gross weight of 104,670 lb. Maximum takeoff gross weight is 113,000 lb. It went into the river about 1 to 1.5 mi. from the end of the runway, adjacent to Riders Island, "pretty much on course," according to a Federal Aviation Agency official. There were eight survivors, including the first of-

The "back course" approach to La Guardia (which has been in use since 1957) utilizes the New Rochelle harbor and radio beacon, and the La Guardia page, which are 4.5 naut. mi. apart. Missions onboard attitudes are

Back on schedule for its 1700 EST New York departure on Flight 393, was pushed back to a 1000 EST takeoff on Flight 510. It finally left the gate at 2115 EST and was airborne at 2134. Until the time of the accident, the three-hour flight was considered routine.

Second paper concerns what is being called *Kampung*. This involves close cooperation between national airlines from the same far countries. *Kampung* reportedly would promote joint investments under which the five carriers would share costs of maintaining jet equipment. The second deal between Sabena and SAS states which these two carriers are jointly buying and maintaining two types of U.S. jet aircraft, seem to indicate the direction in which Europe will move.

The Elster was monitored by radar to New Rochelle, where its approach was initiated. Tower radar did not see the said approach. South also

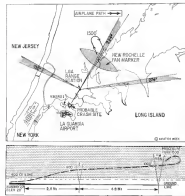
Electra N 51002A, 100 hr., total time. First engine was No. 1, 23 hr., No. 3, 152 hr.,

PanAm 70

Muscarelle, age 47, was at 5 o'clock of Wednesday with several men in an American 707-100 after takeoff on Los Angeles schedule but flew toward what he

The captain was returning to the cockpit and had stopped to talk with Norman F. White, Pan Am's Atlantic Division vice president, when he felt the first change.

Two Air engineering personnel last week were sent to Consett to inspect the 707 for possible damage, and to inspect various flight systems to determine the exact reason for the spiral and dive.



SACK COURSE is on Corral's Highway 22 stillness combined range and U.S. Deviation facilities, across the glade. Normal procedures call for an search to proceed from N. E. Roadside at 1,500 ft. The first radar station at 1,000 ft. and the LaBanza stage station at 800 ft. Minimum sight altitude from range to target 2.5 m or southwest, is 400 ft. Should the aircraft be in contact at the above stated approach procedure would be supplemented which normally calls for an down climb to 1,500 ft. on the southwest corner of the U.S. or range (standing 224 deg. or as directed by Air Traffic Control).

Wing Plate Crack

The crash was detected during the first week of January in the Two Americas airplane, which was reported to be one of the early T87-320s. British newspapers picked up the report and it produced a stir there in the light of early Soviet deliveries (JAW Oct. 25, 1994, p. 17).

Northwest Cuts Overhead, Boosts Profits

By Robert H. Cook

Minneapolis-based lifting into this and a right gain in the airline's average have been blended by Northwest's General Aviation into a profit formula that has propelled the carrier from the status of a \$4 million airline to a \$5.5 million profit in 1958.

The year now record breaking in nearly every phase of Northwest's operation, and stockholders on their own, per share, have risen from \$1.58 in 1957 to \$18.00 in 1958. However, President Donald W. Nyrop, a former Civil Aeronautics Board chairman and in-kind of the Civil Aeronautics Administration, says even greater profits will be needed to handle the \$67 million purchase of 10 Lockheed Electra turboprops and four Douglas DC-8 turboprops on an order plus leasing costs of \$513 million (total order plus general lease) to be delivered under contract in Minneapolis-St. Paul International Airport. He adds that last year's record profit is barely sufficient to pay the \$5,700,000 cost of one DC-8.

Nyrop adds that Northwest's present methods of operation, with a heavy emphasis on a "cost conscious" philosophy, will be equal to the challenge. Today, the airline employs 6,700 persons, has 24,400 seats, a fleet of 10 aircraft, a productivity increase of 21.4 persons per hour (300,000 revenue ton miles produced). In 1957, this figure stood at 47.1 employees and the company expects to bring it down this year to 42.5 by using more automation and by using more equipment and the products produced by new flight equipment.

Low Operating Cost

At the same time, Northwest now reports the lowest total operating cost per available ton mile in the industry. Figures for 1958 are as follows: Northwest at 24.6 cents as of last November, compared with an industry average of 27.1 cents, then cost last year in a steady decline since 1953 when it was recorded by Northwest at 33.5 cents per available ton mile.

Last year, the company's record operating revenues of \$101.2 million reflected a 21.4% increase over 1957, while its operating expenses increased only 15.6% (indicative of Northwest's progress for this year, and the value of its cost-consciousness). Chicago-based airlines last month's operational reports showing a 49.9% increase in domestic revenue passenger miles over the same month of 1957 and a 23.9% gain in international revenue passenger miles.

Northwest economists believe the airline will carry 90,000 passengers a year in its Chicago-Florida route, which was suspended on Dec. 6 of last year. Of major importance, this year, is the new route's potential to maintain the former annual imbalance of traffic which last year caused a loss of \$600,000 for the month of January. This route alone, is expected to give Northwest its last profitable January since 1945 when the company cleared \$18,000.

Company Progress

Nyrop credits most of the company's progress, since he became president in 1954, to the following developments:

- Increased sales promotion.
- Strict adherence to cost control principles.
- Extension of, and renewal of, routes from Northwest's flight system.
- Integration of new flight equipment.

Goodwin W. Hunt, vice president and chief of operations, says the success of the past few years on the theory that the airline industry is a place for "showmanship." This is reflected in the airline's "luxury" and "Regal" flight service, the use of Nino and Charles-Amelino and Flipsa-Amelino on stewardess and domestic flights to state capitals (service to the Coast).

While the airline streamlines all areas of its operation, it has particular emphasis on cost control in a number of "cutting a specific audience," research between men driving to and from work. Hunt expects to increase his advertising budget for radio by 25% this year, but to cut his advertising budget by 10% on television and other less profitable in its programming to coincide with his program. Direct mailings, which also can be reduced and directed to a specific audience, is another method favored by Hunt who said the

media needed a 75% gain in the past 18 months. Newspaper advertising is a year in Chicago-Florida route, which is in a new market area, such as Florida.

Hunt also plans to apply the new techniques to promote both the Electra and DC-8 service, with a heavy emphasis upon expansion of "Regal"-type service.

Another major reason for Northwest's progress, according to Hunt, has been the improved caliber of its men. This includes a better selection of pilots and ground staff and studies designed to provide a variety of such not usually available to airline. The airline also has heightened its inspection of its own staff.

Northwest's present cost control system got off to a gradual start in 1954 after the company's payroll had been trimmed from 1,580 to 4,900 employees in one of the early months taken to cut \$1.5 million from expenses.

The company employed the new system of cost and cost to conduct an efficient study of every phase of its operation. It lists and the study is a basis for use by Northwest's various departments in arriving at attainable goals based on past experience. This new program was first applied to maintenance and, by 1956, was in effect in all divisions. Last year, figures show, an annual improvement of about 32% in the efficiency of Northwest employees.

Manager Planning

Also, the company makes maximum use of its statistical management planning chart instituted in 1954. Planned twice a year for budget purposes, the chart is individualized for each station and lets the company's management, during a 24-hour period. The chart allows station managers to avoid any overlapping of employee duties, and the system has been extended to the airline's general office staff.

Expansion of the Northwest route system from 16,704 in 1955, with 70% of the route mileage now permanently contracted, has played an essential role in the company's progress.

In the last two years, 8,638 miles of Northwest's Coast and Alaska routes have been permanently contracted. Civil Aeronautics Board action in the New York-Chicago Service Case allowed the carrier to close a major gap in its domestic route to service these cities on the same flight and also granted the carrier unrestricted New York-Detroit authority. This situation placed Northwest in the second and seventh largest



First Continental's Air Lines Boeing 707-120 rolls out at London, Wash., Transport Division plant of Boeing Aircraft Co. Aircraft is first of four ordered by Continental LAM Oct. 27.

By 1958, initial deliveries to Continental will be made in April.

domestic passenger airlines respectively.

During that period the Board also has removed legal restrictions on capacity applied to the company's airline out of Minneapolis other than the Chicago route segment, with only 300 seats per hour and Chicago-New York restriction remaining.

CAR's decision to award Northwest a 1,200-mile route extension from Chicago to Miami via Atlanta and Tampa, St. Petersburg has again placed the airline in a better market area, with a high volume of Florida board traffic originating on the Northwest system north and west of Chicago.

While some major route changes, Northwest both its many small communities are needed to fund traffic into the company's longer route lengths. Twelve out of 21 domestic stops on the carrier's system have populations below 50,000, but while the overall distance traveled by a passenger on Northwest's domestic service averages 145 mi., research indicates that the Northwest passenger in the smaller communities travels an estimated 190 mi. per trip.

This type passenger mix serves the needs of Northwest's expected annual revenue of \$11.5 million from the Chicago-Florida route, according to President Nyrop.

Northwest presently has 18 other routes applications pending before the CAB. Largest of these applications involves the New York-Boston-Washington route, which the carrier estimates could provide Northwest with 60,000 passengers a year.

Acquisition of a new fleet of 18 DC-8s and 14 DC-7s in 1957 gave the company its first real competition in jet, Nyrop says. Combined with the airline's new Boeing 737 Stratojets, the strength gives Northwest "top flight" status, service between all major cities

on its system. In both Douglas models, passenger comfort and seating appeal was considered, with Northwest offering breakfast, snack service on the DC-8. Maintenance on the gliding of engines and special other work, including on the DC-7s out of the company's 515,000 per aircraft. Total, Northwest has more daily DC-7 seats available in relation to its fleet than other 11.8 carrier, according to Nyrop.

Last year, the airline disposed of the last of its DC-3 fleet and a new line of each truck order to operate exclusively with four-engine equipment. However, arrangements also were completed last year for a line of four and eight engine turboprops totaling \$83.5 million, most of which will be used for Northwest's purchase of Electra and DC-8s. First of the Electra turboprops are scheduled to be received in July and the balance of the order of 10 by the end of the year. Turboprop deliveries will start in the spring of 1960, with a total of the DC-8 scheduled to be in use by September of that year.

Last of the major carrier to announce jet purchases Northwest last received a home order of \$425,000 which would have been paid out for in 1958 on down payments and progress payments had the decision been made in an earlier date, according to Nyrop.

Thus far, Northwest has obtained \$80 million, payable within a 10-year period from 12 insurance companies and \$52.5 million from 15 banks which must be repaid by Dec. 31, 1967. In addition, \$11.5 million has been received from the sale of 457,875 shares of preferred stock, recently authorized by the company's stockholders.

From the total of \$81.5 million, \$36.15 million will be used to acquire the outstanding portion of the loan on Northwest's DC-7s and DC-8s, with

\$45.35 million applied to the new jet equipment. The additional \$17.75 will be required for the jets will come from company earnings and depreciation, along with funds from the Domestic and DC-7s, totaling \$80.2 million.

A major stipulation in the jet sale contract is that Douglas will allow Northwest \$1,100,000 in each of five DC-7s, while Lockheed will allow \$370,000 each for the nine Strato jets, except with spare parts.

Both of the new aircraft are long range, efficient and extra capacity (offer fuel tanks in the DC-8 along with Pratt & Whitney JT3 engines to improve takeoff thrust and provide on ground power weight). First Electra service probably will be inaugurated on the Chicago-Florida route with the DC-8 scheduled to become a morning trans-Pacific carrier, company spokesmen say.

Although company engineers have completed many engineering studies and specifications, they estimate the following transport will let a full-ton rate of 10.4 hr. as compared to 9.5 for the DC-8. Round-trip load factor for Northwest was estimated to be between 57 and 57%.

Flexibility of its fleet maintenance schedule and procedures is being studied by Northwest because of the problem posed by the speed differences between the piston engine, four-engine and turbojet aircraft. The company now analyzes the passenger block chart within for the DC-8s and DC-7s but is considering a possible change in a continuous maintenance system of the fleet.

Northwest also has registered gains in the field of air freight and Nyrop expects a heavy upsurge in this phase as a result of manufacturers' retooling of production in the field of the business recovery. The airline now operates several DC-8 "combination" aircraft with convertible hold-alls to carry both passengers and freight, on transcontinental routes. Size of other passenger or freight loading can then be changed so that the prospect of unused space is virtually eliminated.

Expansion of the combination aircraft which only can be used when cargo is changed to carry no more than 17,000 lb. of cargo and 25 passengers on a night flight to 10,000 lb. of cargo and 41 passengers during the daytime.

Finally, the greatest boost to Northwest's air freight volume came in its introduction last November of a single, low lift truck designed to bring the entire load of an shipment to West without an crane. It has allowed Northwest to top a new record in revenue ton miles, adding 700 mi. to the total of its domestic routes. Cargo volumes are able to increase through its three freight and intermodal freight miles figured from the distant Northwest station.



Donald W. Nyrop



Supplemental Ruling Spurs New Debate

By L. L. Doty

Washington—Continued over the status of supplemental air transportation is expected to continue in a work of over appeals and petitions despite the recent Civil Aeronautics Board decision to award operating certificates to 23 supplemental carriers.

Reaction to the Board's decision in the so-called-44 Large Inland Air Carrier Case within the air transport industry differs widely. Thus the 23 air men which received certificates of public convenience and necessity for the last year were publicly agreed on only one point: The certificate load the carriers in relation to the scheduled airlines.

Board the one point, however, has scattered confusion among the 23 carriers as to their future role as the competitive scheme of air transportation. Last week, letters approaching a number of the supplemental carriers in which the Board's written decision which one spokesman termed "complex" and an offer "one of the most poorly written opinions I have ever read."

Court appeals and petitions to the Board for reconsideration will arise from the dissatisfaction with the decision in the 22 supplemental carriers which the Board has scheduled for certification. In addition, charges are being made that the scheduled airlines will take action against the decision once their analysis of the system is completed.

Case Features

Here are the principal features of the Board's decision in the Large Inland Air Case which began in 1951:

- **Supplemental carriers** will be permitted to operate individually scheduled passenger and mail/rail freight service within the U.S. on a scheduled basis with a limit of 30 round trips per month per airline between any two points.
- **Carriers** may conduct scheduled domestic charter service without frequency limitations. Operating rights are virtually the same for charter and scheduled flights in these quarters under transport authority in 1953.
- **Decisions concerning** length or excess transportation for supplemental air service will be based on the future.
- **Five-year certificates** were granted a total of 12 carriers. Two-year certificates were awarded to the balance of 11 carriers. Three additional applicants were found to be qualified but a filing of specific applications will be required before final determination can be made. Refusing will be held on the cases

which did not receive certificates. Total of 22 applicants were found "not qualified."

In the first two decisions, with Vee Charterline, Chas. Gandy and Mosler-Hamner, Dornier, the Board explained that the over certificates were granted to carriers whose qualifications are clear and strong. "Two-year certificates were awarded carriers whose qualifications are acceptable or better but range below those of the first group."

The Board did not state the date to adjust supplemental carriers but will continue to consider applications for temporary certificates in the supplemental class as being and decision. It said, however, that it does not intend to reconsider the scope nor the need for supplemental operations.

The Board decided that supplemental carriers filed an important need for periodic level demands that exceeded the list of scheduled airlines. It called for the "one" of the over certificates would carriers be issuing the certificates to foster their continued growth to improve service to the public.

The Board specified that the new certificate class was prohibited from jointly advertising or publishing schedules with another air carrier or with a ticket in cargo agent. This was undoubtedly designed to block the creation of scheduled line certificates. In addition, charges are being made that the scheduled airlines will take action against the decision once their analysis of the system is completed.

Most supplemental carriers potential vehemently against the 10-year rule as a restriction that would prevent normal profit growth for the individual carriers. Advertising restrictions and the rule against the use of travel agents also were pointed to as factors that would hinder normal development of traffic growth. A number of carriers made the case against the 10-year rule had been expected by them in the final decision.

Charles Russell, executive director of the Independent Airlines Assn., said that "Supplemental carriers are the backbone of the supplemental airline industry can survive under the economic conditions laid down" by the Board and added: "This decision is not the best and worst for the independent airline industry."

Carriers that some of the 23 supplemental carriers would make a bid to join the Air Transport Assn. appeared strong last week. "Possibility, the carriers are that they are not qualified to join the association although the ATA had reached no decision on this matter by late last week. At least three of the carriers plan to apply for membership immediately.

Such a move is not likely to affect the status of the Independent Airlines Assn., which has 11 of the 23 carriers in its membership. At the recent Air Carrier Conference with five of the newly certified carriers among its members.

Fight for membership in the ATA, however, will take into consideration also court appeals and petitions to the Board for reconsideration begin to appear. There are the same prospects.

Future Appeals

- **Scheduled carriers** can be expected to appeal the case. Arguments of the Board to grant certificates with limited operating rights will be considered. Appeals before the courts that the Board's findings are incorrect and, however, were insufficient are still pending and may complicate the case.
- **New carriers** will file for certificates in accordance with the decision in the Large Inland decision, applicants in the supplemental class.

• **Carriers** facing to secure certificates probably will petition the Board for reconsideration and a number will take the case to court. Because of the large number of geographical areas involved, an actual appeal would probably require more than a few months passing a settlement of the case.

• **Court case pending** from 1955 can be reactivated. Scheduled airlines at that time opposed a Board decision which established that there was a need for supplemental carriers, a class would be created and complete would be made pending a decision. The court rendered the case to the Board on the ground that exceptions could not be granted since it had not been shown that it would be an undue burden to new entrants.

Carriers serving foreign markets are All American Airways, Airline Pacific, Associated Air Transport, Airline Corp. of Seattle, Blue Airlines, Coastal Cargo Co., General Airways, Johnson Flying Service, Oceanic National Airways, Southern Air Transport, Standard Airlines, Stuart Air Service, Transwestern Air Lines and World Airways.

Carriers winning two-year certificates are All American Airways, Airline Pacific, Associated Air Transport, Airline Corp. of Seattle, Blue Airlines, Coastal Airlines, Modern Air Transport, Paul Meier Air Services, Regan Cargo Airline, Seaboard Air Transport and United States Ocean Air Lines.

KLIXON 3-PHASE AIRCRAFT MOTOR PROTECTORS



Guard Against
Overtemperature
in AirResearch
Condenser Fan



Roy Klixon, left, Senior Product Engineer, and Phil Lytle, Design Specialist, examine the AirResearch Condenser Fan used on the Boeing 707.

Affairs Manufacturing Division of the Garrett Corporation, long a leading manufacturer of electro-mechanical components and air conditioning systems for aircraft, is a major user of KLIXON Inherent Overheat Motor Protectors.

Elvin Lytle, Design Specialist of AirResearch, selected a 3-phase KLIXON Motor Protector

for use in this 10 HP electric motor driven condenser fan, a component of the vapor cycle air conditioning system on the Boeing 707 Jet Streamliners ordered by American Airlines. In this application, the KLIXON Protector shuts off the fan motor if excessive inlet air temperature or inadequate air flow causes the motor windings to overheat.

METALS & CONTROLS

Spencer Division



CORPORATION

3102 Tenth Street, Arlington, Mass.

KLIXON

The Record Breaking Rotodyne



191 m.p.h. proved world's fastest rotorcraft

The Rotodyne vertical take-off aircraft has established itself as the fastest rotorcraft in the world. On 15th January, 1959, it first crossed a 52 mile closed-circuit record course at an officially observed average speed of 191 m.p.h. for a new world circumnavigation record—at cruising power and operational weight.

The record, almost 35 m.p.h. faster than the corresponding take-off record and 30 m.p.h. faster than the absolute speed record for helicopters—both held by conventional helicopters—confirms Fairey's claim that the new V.T.O. aircraft is fast, sure, for any-where in any-where country, meeting its objectives, meeting its valuable role.

(Quoted in F.A.E. Conference)

FAIREY
Rotodyne

Powered by Napier Lion heli-prop

Amesbury, Mass.

THE KAMAN AIRCRAFT CORP.
BLOOMFIELD, CONNECTICUT

THE FAIREY AVIATION COMPANY LIMITED
HAYES - MIDDLESEX
ENGLAND - AUSTRALIA - CANADA

Airline Income & Expenses—November, 1958

(IN DOLLARS)

	Passenger Revenue	U.S. Mail	Freight	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income (Before Taxes)
DOMESTIC TRAFFIC								
American	24,779,480	419,236	2,338,128		24,280	27,546,264	24,771,561	2,774,703
Boeing	4,950,189	189,481	46,119	143,352	48,454	5,336,136	4,406,467	929,669
Capital	1,352,444	36,488	15,490	26,710	3,876	1,524,728	1,467,623	57,105
Continental	3,316,481	41,736	12,444	64,730	13,443	3,448,794	3,384,999	63,795
Delta	7,353,000	91,200	112,000	99,000	49,200	7,615,200	6,736,807	878,393
Eastern	13,432,497	271,733	715,317		17,114	14,436,761	14,322,794	113,967
Northwest	4,472,199	101,738	35,442	128,440	57,518	4,795,337	4,441,534	353,803
Republic	1,416,121	29,413	15,004	31,334	10,300	1,501,872	1,427,284	74,588
TWA	5,638,951	85,383	441,911		23,321	6,190,566	5,526,915	663,651
Trans World	15,716,150	265,923	485,847		45,954	16,493,924	15,745,917	748,007
United	30,975,922	712,874	1,472,115		194,314	33,355,225	32,525,800	829,425
Western	2,728,701	81,834	28,200	71,118	47,423	2,949,186	2,734,799	214,387
INTERNATIONAL								
American	338,444	3,363	48,018			409,825	379,520	30,305
Boeing	259,565	10,464		48,425		278,454	248,434	30,020
Continental-Norfolk	125,117	2,739	7,443		3,728	139,027	137,204	1,823
Delta	312,666	5,805		9,000		327,471	246,502	80,969
Eastern	1,117,315	36,813	52,937			1,207,065	1,155,119	51,946
Northwest	818,700	1,244	3,804	7,807	41,921	873,576	748,747	124,829
Republic	1,479,379	731,234	315,347			2,525,960	2,442,394	83,566
Trans World	129,600	12,800		36,000		178,400	128,388	50,012
United	2,437,604	887,882		1,491,700	141,000	4,917,186	4,741,118	176,068
Western	4,618,000	187,800		1,215,700	210,000	6,031,500	5,747,198	284,302
Boeing	3,714,000	141,800		181,000	881,000	4,826,800	4,532,006	294,794
Continental	1,120,000	45,000		144,000	12,000	1,341,000	1,215,192	125,808
Delta								
Eastern								
Northwest								
Republic								
Trans World								
United								
Western								
LOCAL SERVICE								
American	224,441	12,447	11,338	16,338	617	256,181	215,288	40,893
Boeing	215,880	3,306	1,304	3,808	3,443	226,741	199,620	27,121
Capital	121,612	7,838	1,116			130,566	118,746	11,820
Continental	313,419	305,221	3,980	25,338	7,817	620,765	585,942	34,823
Delta	195,189	4,534	5,545		3,614	208,282	187,607	20,675
Eastern	294,382	8,748	18,809		1,864,800	2,126,739	2,045,348	81,391
Northwest	461,320	22,736	16,300		37,118	537,474	498,873	38,601
Republic	435,844	364,170	11,361	11,440	37,444	848,819	794,426	54,393
Trans World	136,157	8,882	2,700	7,312	17,146	182,095	174,168	7,927
United	519,346	1,054	4,837			525,237	482,388	42,849
Western	257,302	10,782	3,940			272,024	249,469	22,555
Boeing	245,304	3,607	1,223	3,244	3,212	255,390	237,264	18,126
NAVIGATION								
Boeing	383,724	1,491		20,874	12,819	418,908	408,778	10,130
Trans World								
CARGO INCOME								
American				112,807	11,844	124,651	115,404	9,247
Boeing					1,742,118	1,742,118	1,685,061	57,057
Capital					307,471	307,471	301,724	5,747
Continental								
Delta								
Eastern								
Northwest								
Republic								
Trans World								
United								
Western								
HELICOPTER INCOME								
Boeing	54,399	101,917				156,316	125,702	30,614
Continental	13,243	8,732	3,219			25,194	21,779	3,415
Delta	55,641	3,361	2,941	3,116		65,059	53,204	11,855
ALASKA INCOME								
American	127,442	25,641	880	34,947	84,147	178,916	161,221	17,695
Boeing	15,784	15,282				31,066	28,134	2,932
Continental								
Delta	20,320	2,440			3,551	26,311	22,007	4,304
Eastern	44,471	20,862			820	65,153	55,794	9,359
Northwest	402,925	85,379	16,497		6,417	494,218	454,213	40,005
Republic								
Trans World								
United								
Western								

* Not available.

* Property figure.

* Federal subsidy included.

* Not included service.

* Not operating profit or loss.

* Cargo, express, & other.

Compiled by AIRCRAFT WEEK from airline reports to the Civil Aeronautics Board.



Fueled... Lubricated by Sinclair

Electra—the maiden in Greek mythology who became a star in the heavens—is the apt name given by Lockheed to its new propjets. Forty of these new ships are joining Eastern Air Lines' fleet. Each carries 66 passengers in smooth quiet, and hops non-stop over key Eastern route at 400-450 m.p.h.

Sinclair has been a jet fuel supplier to the military for eight years, and is proud that Eastern has chosen Sinclair Superjet Fuel for the Electra. Eastern has also selected Sinclair Aircraft Turbo-S Oil for exclusive use in this magnificent propjet fleet—proof positive of the dependability of Sinclair's aircraft fuels and lubricants.

SINCLAIR AIRCRAFT FUELS AND LUBRICANTS

Sinclair Refining Company • Aviation Sales • 680 Fifth Avenue, New York 20, N.Y.

SHORTLINES

► **British European Airways** Rolls Royce Dart turboprop engines installed in its fleet at Victoria Airport have flown a total of more than 1.1 million hours. B.E.A. says the Dart 510 has a life of about 2,000 hr before overhaul; the Dart 520 an approved life of 1,800 hr.

► **Civil Aeronautics Board** has granted a height air carrier permit to Aero Lines Peruvian, S. A., Peru, for a period of one year. Permit will become effective only after the carrier has demonstrated itself from all non-Peruvian sources, primarily Transperu Aerios Nacionales, S. A., (TAN), of Honduras.

► **Eastern Air Lines** will begin Lockheed Electra service between New York and San Juan on Feb. 22. Flights will leave New York International Airport daily at 9 a.m., arrive at Puerto Rico International Airport at 2:30 p.m., local time. The flight will leave San Juan at 5 p.m., arrive New York at 3:55 p.m.

► **Japan Air Lines** international operations overseas increased 55% in December, 1957, to 53,792 tons and domestic accounts rose 2% to 5690,472. Total operating revenue for the month rose \$2,486,357.

► **KLM Royal Dutch Airlines'** board of directors has endorsed the airline's management recommendation to declare a 4% dividend on KLM's 100 guilder per value common share which, at the present rate of exchange would be equal to \$1.06 per common share in holders of shares of New York registry.

► **Midwest Airlines** carried 444,659 passengers, 85,142,800 passenger miles during 1958, increases of 6.3% and 6.97% respectively over 1957.

► **National Airlines** reports net earnings of \$718,917 for the last six months ending Dec. 31, against a net loss of \$1,181,165 for the same period of last year.

► **Southeast & Western Airlines** last week began scheduling daily transit traffic mail and all-cargo service beginning Feb. 2. The flights will serve 15 European cities in seven countries.

► **Southern Airlines** reports a net income of \$304,800 for 1958, equal to 96¢ cents per share, on 252,000 shares outstanding. Total earnings for the year were \$5,600,800, up 22%.

► **Trans Canada Air Lines** earned more than 24 million lb of air freight and 6,000,000 lb of air express during 1958. Last quarter 1958 air freight earnings rose 600,000 over the 1957 figure.

AIRLINE OBSERVER

► **Witch's** set for a vote by Pan American World Airways to purchase a fleet of Convair 440 turboprop transports for use on its South American routes. Transaction is now in the discussion stage.

► **United Air Lines** will increase its order for Boeing 720 medium-haul jet transports within the next few months.

► **Port & Whitney Aircraft** is developing a new combination engine supercharger and thrust reverser of the duct type. The new device will be offered for mechanical use with JT3 and JT4 engines such as Douglas DC-6 and Boeing 707 series aircraft. New Port & Whitney turboprop engine will be offered for transport use with a thrust reverser but will not require a duct supercharger.

► **American Airlines** sale of 25 DC-7 aircraft to General Aircraft and Leasing Co. at a cost of \$22.5 million has been set aside for an examiner's hearing by the Civil Aeronautics Board. The two companies' request for a discontinuance of proceedings has been deferred by the Board pending the hearing.

► **Trans World Airlines** is operating a Boeing 707-113 transport for flight training purposes from its Kansas City headquarters base. The airplane, which carries TWA's markings and insignia, is no less than the Hughes Toulon. According to a report to the Civil Aeronautics Board for approval to leave the place, an arrangement between the two companies have yet been made for the lease to sale of the interest of the 15 707s on order by the Hughes Toulon Co.

► **Grand American Airlines** will purchase two Douglas DC-6Es from Strahl Aviation Systems and will increase the order to four at a later date in the carrier's first bid to operate a route in Latin and Mexico from Mexico.

► **Pan American World Airways** and Port & Whitney have devised a procedure for the partial conversion of a recent batch of two JT3 engines on a Boeing 707 shortly after takeoff from Port. Engine accessories were caused by water leaking from a hardened seal on the water injection system and collecting in an engine support strut. Actuation of the de-icing system, which uses a variable nozzle blast of hot engine air bleed, blew the collected water from the strut into the combustion chamber at high velocity, causing the flame. Engine de-icing system is now activated before using water injection so that instead of the spiral water nozzle blast, a lower velocity small nozzle stream of hot air is blowing when the water injection occurs. Meanwhile, development of a more efficient seal for the water injection system is under way as a permanent fix.

► **Civil Aeronautics Board** has called for an inquiry into testing configurations of all aircraft operated or to be operated by domestic airlines to determine whether a full investigation of testing standards is necessary.

► **American Airlines** has contracted with Douglas Aircraft for the conversion of 10 DC-7Bs to cargo aircraft at a cost of \$4.2 million. Conversion program, scheduled to be completed by August, 1960, will allow an easy access to the problem of unsuitable disposal and will more than double the carrier's freighter fleet capacity which now consists of 30 DC-6As.

► **Presidents of five airlines** and one local service carrier and the Air Transport Association will meet today with heads of International Air, of Mackinac, Flight Engineers International Association, and Air Line Pilots Assn. at a labor-management conference called by Labor Secretary James Mitchell. Mitchell, who is calling a study meeting with the railroad industry next week, is seeking methods to prevent disruption of transportation facilities by strikes. Airline presidents met in Washington last week to plan strategy for the meeting.

► **CSA, Czechoslovakia** (note airline), will replace Tu-104 turboprop transports with Tu-154 turboprop aircraft on its Prague-Praha route. The Tu-104s will be converted to the Prague-Czech route.

A NEW ERA IN JET POWER



THE ROLLS-ROYCE CONWAY BY-PASS JET ENGINE

has now been granted a full certificate of airworthiness by the Air Registration Board at a minimum rating of 17,000 lb. thrust. Conways are now being delivered to aircraft manufacturers.

ROLLS-ROYCE EXPERIENCE IN THE AIRLINE OPERATION OF GAS TURBINES IS UNIQUE



THE DART

—the first, and for four years the only prop-jet in airline service has flown over 6,000,000 hours. The Dart is currently operating at overhaul lives of up to 2,500 hours.



THE TYNE

—a most advanced prop-jet engine, is due to enter service in 1960 at ratings of 4,965, 5,525 and 5,730 h.p. It has a specific fuel consumption comparable with the latest compound piston engines.



THE AVON

—the first turbo jet on the North Atlantic route, and now in daily service, began scheduled operations with an approved overhaul life of 1,000 hours.



**DEVELOPED
FROM
EXPERIENCE**

The by-pass principle which Rolls-Royce have proved in the Conway engine is now accepted as the correct formula for all jet transport and for certain military applications.

The new RS 141 family of by-pass jet engines is based on seven years' development experience of the by-pass principle gained with the Conway and on six years' operation of other gas turbine engines in airline service. The first of this series has already been chosen to power the new British European Airways medium range jet airliner.

ROLLS-ROYCE

GAS TURBINES

ROLLS-ROYCE LIMITED, DERBY, ENGLAND

AERO ENGINES • MOTOR CARS • DIESEL AND GASOLINE ENGINES • ROCKET MOTORS • NUCLEAR PROPULSION



.....RADAR SIGNALS FROM SPACE.....

When man first takes a rocket into the fringes of our atmosphere, tracking systems on the ground will know his position and its velocity from signals beamed to earth by a tiny radio transmitter.

This Stavida-developed and Stavida-built beacon receives transmissions from ground radar sets on the ground and develops coded pulses for identification and tracking. The system provides for the passage of data in both directions, and permits working at greater distances than ever before. This development represents new gains in instrumentation techniques achieved by Stavida engineers, who are steadily advancing the state of the art in electronic space engineering.

OTHER AIRBORNE PROJECTS INCLUDE:

- High power Modulator Transmitter for Radar Set AN/SPQ-7
- Search and Tracking Radar Set 300B GEN OASB
- All-Weather Radar Test Dangling System

STAVIDA Engineering, Inc. Pittsburgh, New Jersey

Imaginative Electronics...

Outstanding engineers and specialists are invited to explore new opportunities in Stavida's advanced electronic engineering fields.



Stavida's Chief Engineer, H. L. MacCallister, has 20 years experience in the development of radar systems, including the Search and Tracking Radar Set 300B GEN OASB and the Radar Test Dangling System.

SPACE TECHNOLOGY

20 Million lb. Thrust Engine Foreseen

By Michael Yaffe

New York—First 1.5 million lb. thrust liquid propellant booster, which will be a cluster of existing rocket engines now in production, is expected to be ready for testing within a year and to be launched before 1962.

After this, following a several years of development, will come the single chamber liquid booster to the 1-1.5 million lb. thrust class.

The single-chambered engine is expected to be operational about 1965 and to serve as a stepping stone to one substantially larger engine which will follow shortly thereafter.

These expectations were expressed by Thomas F. Dixon, chief engineer of North American Aviation's Rocket Division, here at the annual meeting of the Institute of the Aeronautical Sciences.

Looking into the future of rocket propulsion over the next 25 years, Dixon proposed the inevitable:

- One and a half million pound thrust liquid propellant rocket engine, clustered 150,000 to thrust chambers. Unit will be ready for testing in 1960 and could be operational before 1965, provided money, which is ready at that time.
- One to one and a half million pound thrust liquid propellant rocket engine, single chamber. Engine is expected to be operational about 1965.

• Five million pound thrust engine, clustered 1.5 to 2 million lb. thrust units, could be ready in 1970.

• Five million pound thrust engine, single chamber could be operational about 1975 or 1977.

• Twenty million pound thrust engine, clustered 1.5 to 2 million lb. thrust units, will be potentially available by 1975 or 1977.

• Twenty million pound thrust engine, clustered 5 million lb. thrust units, could be ready within the next 15 years or by 1994.

Other Engines

Other engines which Dixon believes will find space propulsion applications and which can be developed within the next year are the one rocket engine, the nuclear engine, and the thermocouple engine. Under development now, the one rocket could be available in five to 10 years depending upon the emphasis placed in the program.

A nuclear engine of 1.5 to 2 million lb. thrust could be operational by 1975. While nuclear engines will be complicated, and possibly, competitive with future chemical engines, they also appear to be indispensable for an ambitious extraterrestrial mission, according to Dixon.

The thermocouple engine is, in his opinion, one of the most futuristic approaches to interplanetary flight, but it could reach the earth stage of development in about 25 years, provided controlled fusion can be achieved in the near future.

Granted, from Dixon's calculations, but almost certain to be a factor in the future development of space, which propulsion systems are the solid propellant rocket engines. Until recently confined to the field of high rocket engine development, solid propellant rocket manufacturers are now preparing to move into this last category of the liquid propellant engine companies.

A prominent integrator at the propulsion seasonal gathering period, H. L. Lam, Throckmold, Jr., senior vice president of Grand Central Rocket Co., told Aviation Week that his company could get a four-stage solid propellant space vehicle at Vandenberg Air Station 31 years. The vehicle would have a 1.5 million lb. thrust first stage weighing 500,000 lb., and total propulsion system would cost less than \$100 million.

No more speculation, and Throckmold



MAJOR ENGINE CLUSTER



SIDE PROFILE OF LARGE THRUST ENGINE, DESIGN



TOP VIEW OF LARGE THRUST ENGINE, DESIGN



CLUSTER OF EIGHT, 150,000 lb. thrust, Thor Jupiter engines (top) is fast step to development of "space" space propulsion system. Later steps will involve single-chambered 5 million lb. thrust engine and then cluster of these to form a 20 million lb. booster (center). These will be followed by larger clusters and development of nuclear engines (bottom), which will be used for man's ultimate space missions.



ONE approach to thrust modulation of solid propellant rockets is this pusher scheme suggested by Throckmold's Dr. H. W. Reber. External chambers would move cases in and out, thereby regulating openings in the auxiliary exhaust ports.

Arrow CF-108 Arrow
Covers a second
superiority fighter

In the Arrow's twin

IROQUOIS turbojets...

TITANIUM CUTS WEIGHT 57%

in compressor blade
assemblies



Stainless steel engine
performance was
50% in Arrow

Turn Generalized Titanium jet engine will speed the Arrow Arrow through space at 30 miles per minute. In these advanced design turbojets, as in the aircraft structure itself, every pound of weight saving becomes a vital consideration.

To design designers, titanium's high strength-to-weight ratio proved a double bonus. By using titanium in place of stainless steel for compressor blades, much lighter titanium disks could also be used. Result: A total weight saving of the assembly of 57% (see diagram). In addition, lighter structural members could be used, contributing further weight savings and improving performance.

Mallory Sharn, in cooperation with Alcoa Titanium, Ltd., produced many of the titanium alloys which help make possible the Arrow's superior performance. These same technical and production facilities are available to you now. In fact, you are using titanium's outstanding physical and mechanical properties to maximum advantage. Write us for information or technical assistance.

MALLORY SHARN

MALLORY SHARN METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

roll, these structures are based on a through study which the company has recently completed and which it will use in the future for formal proposals. Generalized hopes to make one. On an informal basis, he has already started to get some responsible scientists interested, he said.

Transportation Aspects

Among other things the study goes into transportation. After checking extensively with airlines, Generalized concludes that flat cars, trucking and tunnel chambers are adequate for moving all stages of the vehicle, even the fully loaded first stage. On one assembly of the stage cars is handled in standard logging equipment.

Nor does the study focus on particularly severe technical difficulties that will lend themselves to "tailor-made" engineering solutions. The development of cracks in the solid propellant tank must not be expected to be much more troublesome than in a regular solid unit.

Cracks usually develop close to the star points of the nozzle burning surface, past Thackwell, and the nozzle diameter won't vary greatly regardless of total diameter or size of the gas.

Flexibility, he said, if it is needed, can be achieved, said Thackwell. One way, he suggested, would be to open and close nozzle side ports. As pointed out by Dr. David W. Ratner, vice president and technical director of Thiod Chemical Corp. in Rocket Division, who spoke on the problems of solid propellant solid thrust control at the Institute of the Aeronautical Sciences meeting opening with one wall ports of additional cylinder area will provide a wide variation in pressure and thrust. An extremely supported profile arrangement around the base of the thrust chamber can be used to vary the backward reaction jet by inserting or withdrawing small cones from the nozzle ports.

Home Temperature

The problem of providing these temperatures that would occur in the throat of huge, uncooled solid propellant rocket motors would be solved, is it is now being solved by the use of high temperature ablative material.

A more severe difficulty, particularly in a 500,000 lb solid rocket might be cheap. A thermoplastic solid propellant is not a strong enough structure to support all this weight and the material would tend to warp on its own. To remedy this Thackwell said reinforcing rods could be used. These would be made out of some material such as aluminum or magnesium, he said, which would be contained in the course of burning and would add thrust in the manner of the metal additives now

The measuring of high strength hydrogen peroxide, an oxidant in the rocket boost engine of an advanced Navy weapons system, presented unusual problems. The characteristics of H_2O_2 severely limited choice of transducer materials. In addition, requirements called for extreme accuracy, a low pressure drop and a readable, reliable signal in a package of minimum size and weight. Revere solved this problem with a flow-measuring system utilizing materials compatible with H_2O_2 and engineered specifically for the density and viscosity of the fluid. This system provides over the entire flow range, better than $\pm 1.5\%$ accuracy, in low pressure drop, and a modulated signal of 2.5 volts amplitude which requires no external amplification.

The H_2O_2 flowmeter is only one of the many specially designed Revere flow measuring units. Impeller meters and positive displacement meters, gravimetric meters for ground fueling and flowmeters for "buddy system" refueling—all are engineered to meet specific requirements.

Special Solutions to Uncommon Problems in Flow Measurement



**CALL ON REVERE
WHEN YOUR PROJECT RATES THE BEST
RATHER THAN "OFF-THE-SHELF" TREATMENT**
when you want engineering abilities and specialized facilities
in the field of:

- Liquid Level Indicators and Control
- Flow Indicators and Control
- Flow Measurement
- High Temperature Wire and Cable
- Thermoplastic Wire and Cable
- Thermoplastic Wire and Cable
- Electrical and Machine Elements
- Weight, Force and Torque Measurement
- Determination of Center of Gravity
- Strain Gage Load Cells

**REVERE
CORPORATION
OF AMERICA**

Wallingford, Connecticut

A SUBSIDIARY OF WESTERN UNION COMPANY

revere

New Plasma Torch Service for Production Parts from Refractory Metals—By burning the highest controlled temperatures ever used in industry—up to 30,000 degrees F.—the new Plasma Torch makes possible the fast and accurate mass production of ultra-hard materials that have been virtually unworkable by any previous means.

With the patented Plasma Torch, Linde is equipped to supply parts made of, or coated with refractory metals, or made of a variety of metals combined with non-metals or reinforced plastic. This method has been used successfully with pure tungsten, molybdenum, zirconium, and tantalum (all metals in the highest temperature range), hard ceramic materials, and even precious metals, including platinum and gold.

In powder or wire form, the metal being worked is fed into the torch chamber where a non-tempered electric arc generates temperatures above



15,000 degrees, literally melting the particles to a dust or plastic state. Inert gases, flowing continuously, deposit them at near-sonic speeds on the work-piece. Jets of CO₂ cool the particles instantly to form hard-and-wear-resistant material. Coatings, even on graphite, have an excellent bond. Shapes are built up on machined mandrels which are then etched away to leave the finished parts.

There are no known limitations on size or complexity of shape. Accuracy of .0001 in. can be maintained. The Plasma Torch has been used to make high-density tungsten crucibles, special parts for nuclear work, sensitive electrical contacts, and electronic components and x-ray targets. Linde will also provide a wind-tunnel materials testing service based on this device.

For information on this extension of Linde's well-known Flame-Plating service, write Dept. AW-22, Linde Company, Division of Union Carbide Corporation, 30 East 43rd Street, New York 17, N. Y. In Canada: Linde Canada, Division of Union Carbide Canada Limited.

FOR MEN WITH IMAGINATION

Three-Level Ruby Maser—The Maser is a microwave amplifier utilizing energy stored in a molecular or atomic system. Regardless of this energy is stimulated by the input signal. Masers operate at liquid helium temperatures and have incredibly low noise levels approaching zero db. Recently a University research laboratory* used Linde single crystal synthetic ruby (Al₂O₃ with Cr₂O₃ additive) as a three-level solid state Maser. The ruby crystal was placed at the center of the Maser's tuned cavity and a magnetic field of 4500 gauss was applied. To bring electrons from a ground state into a permissible higher energy level, a pumping frequency of 84 Mc was used and the Maser successfully amplified signals at 9.5 kMc.



Linde also supplies other crystals including sapphire, quartz and sapphire (Al₂O₃). Sapphire is used in infrared optical systems, windows for high power microwave tubes, spacers and supports in vacuum tubes, radiation pipes. It has strength at elevated temperatures, melts at 2040°C, is hard, inert, non-porous and can be sealed to metals and glasses. Sapphire is currently available in the shape of domes, windows up to 4 1/2 inches in diameter, rods and special configurations.

For further data write to Crystal Products Department-AW-31, Linde Company, Division of Union Carbide Corporation, 30 East 43rd Street, New York 17, New York.

*"Maser Action in Ruby," by G. Meltzer, C. Kinsler, J. Lander, and R. W. Teetsma, "Physical Review," Volume 108, Number 4, Page 1399, Feb. 15, 1965.

PRODUCTS WITH A FUTURE



The three "L" and "U" Union Carbide and "Linde" are trademarks of Union Carbide Corporation. © 1965 LINDE

being used in the smaller rockets. All in all, Throckmold said, on a weight-to-weight and stability stage basis solid rockets will give the same performance as liquid rockets even with the highest specific impulse liquid propellant available. Moreover, he said, solid rockets are easier to stage and develop, are more reliable, and are cheaper to develop and use.

All this, however, does not obscure the fact that the liquid propellant engines have a head start in the space propulsion field. The first two engines in Deane's timetable are already under development at Rocketdyne. The 1.5 million lb thrust clustered booster is for the Advanced Research Projects Agency, the single clustered 1.5 million lb thrust engine, for NASA.

Scouting these two engines are approximately five years of development time. 100% difference in payload capability, and significant differences in development problems and philosophy.

Development Time

Naturally, Deane said, it takes a minimum of six years to get a rocket engine from the drawing board to the testing stage. But by building from existing components of the Thor and Jupiter Rocketdyne expects to have the first stage booster ready for testing sometime in 1969. The engine, he added, is extremely simplified for the stated objective. In essence, it consists of eight 150,000 lb thrust engines arranged in two concentric rings.

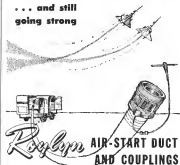
This clustered booster, he said, will be capable of placing a five-ton payload into a 27,400-mi earth orbit in all but one of the ways possible on the rocket. On the other hand, its single clustered counterpart, which is expected to be operational in about six years, will provide twice the payload capability for the same gross liftoff weight. It will be able to place a 20,000-lb clustered satellite in orbit or to send a 5,000-lb vehicle from earth to another planet.

The single-clustered booster, however, will require a turnaround development effort. Among other things, Deane said, the engine will require larger test stands, instrumentation with the power output of small microprocessors to feed the propellants into the combustion chamber, stable combustion chambers with combustion densities many times those of existing engines and such things as plumbing and valves that he believed the range of current experience.

Once this single-clustered engine is built, Deane said, a liquid next step will be to put this, too, into use. But all from together to provide a 5 million lb thrust booster. Such an undertaking is expected to prove considerably more formidable than anything that preceded it. Testing, handling and operation

MORE THAN 1200 SCRAMBLED STARTS!

... and still going strong



FIELD TESTED FOR ENDURANCE

This duct-coupling assembly has been field-tested under maximum wear and tear conditions with as many as more than 1200 scrambled starts... and still going strong! A company in every respect, the Raylyn Duct-Coupling Assembly sets the pace for faster, fuelproof starts of the nation's mighty jet engines.

GREATER PRESSURE RANGE

[Start] Operating 75 psi, Fuel 150 psi, Fuel 225 psi [Coupling] Operating 300 psi, Fuel 175 psi

MAXIMUM TEMPERATURE

The Raylyn Duct is rated for 500°F. operating temperature, and, with

the insulating effect of the outer jacket, heat transfer to outside wall is minimized.

EASE OF OPERATION

The Raylyn Coupling provides either layover or manual disconnection. The Raylyn "Quick" coupling provides almost ease of operation.

SAFETY

This coupling features an enduser safety valve to prevent flow of air when disconnected thus eliminating possibility of back-whipping at hot or loose.

RUGGED CONSTRUCTION

This coupling has been dismantled more than 2500 times with no corrosion from the heat. The duct is constructed of pliable and durable material for maximum flexibility and durability.

BEST by TEST . . . Specify Raylyn Air-Start Equipment





numbers you
can count on
up here...



because they're
proved right
down here!

Hoffman test equipment checks TACAN accuracy—on the bench or in the cockpit

ILL-10 TACAN SIMULATOR duplicates all functions of the AN/URN-30 airframe beacon. Tests ARN-21 for full accuracy and entire range, closure and departure speed, surface beacon identification time and dwell time. Performs fly tests or cockpit check. Available on 60-day delivery.



ILL-10 TACAN TEST INSTRUMENT. Portable unit tests accuracy of ARN-21 airborne TACAN in the cockpit or on the ramp or on the deck. Checks accuracy of range and bearing at zero-net points and identification signals. Availability on request.



TACAN tells the pilot which way and how far to his base, station, or carrier in any kind of weather—a good reason why his AN/ARN-21 performance must be next to perfect.

To maintain the high degree of accuracy engineered into airborne TACAN equipment, Hoffman Laboratories has developed specialized test equipment to check function and accuracy on the ground—before a flight or after repair.

Compact and rugged Hoffman simulators can be earned and installed as standard test gear to every operating site or repair station—military, commercial, government or private installations. Write for further details.

*TACAN-Air Navigation

Hoffman Electronics CORPORATION

HOFFMAN LABORATORIES DIVISION / 2148 South Grand Avenue, Los Angeles 7, California

Mobile Support Equipment • Radio • Communications • Electronic Countermeasures • Navigation • Communications • Electronic Warfare • Electronic Warfare • Electronic Warfare • Electronic Warfare

will present tremendous problems. The control of thrust vector here is an unknown quantity, and fabrication of thrust structure will present problems.

Despite the problems, Drury expects that the clustered 5 million-lb thrust engine will be followed in the development of a single-chambered engine with the same thrust rating. This engine will be so large that fabrication and testing techniques will be different from those employed for one engine up to this time.

Assembled at Launch Site

The one thing that engines will probably be assembled—possibly fabricated—at the launch site—in such the same way sleep on, concentrated in segments from which they are launched. Tank structure, heat transfer, propellant passage and other details like liquid controls, and chamber combustion instabilities will also present serious problems. Propellant lines are expected to run to the air ducts, and telescopes to feed the propellant into the thrust chamber will probably have to have a rating of 750,000 lb.

Most of the component parts of these large engines, Drury said, will have to be integrated into the chambers. The large turbochargers, required to drive the propellant in a 5 million-lb thrust engine, for example, will probably be located in a spike in the center of the chamber. The chambers themselves may be of cellular structure or have a variable angle area for maneuver thrust at all altitudes.

Continuing the trend and in face of the problems involved, Drury said the next step to expect will be the development of a 20 million-lb thrust booster made up of 15 million-lb thrust units. This would undoubtedly be followed in the development of a more sophisticated 20 million-lb thrust engine from a cluster of 5 million-lb thrust units. The chambers in chemical engines, would come into being within the next 15 years and would be capable of placing a 500,000-lb payload in a low orbitable orbit—200,000-lb payload on the moon or entering a 60,000-lb payload around Mars and returning it to earth.

Non-Chemical Engines

Sometime during the next year, Drury said on the nonchemical engines will make their appearance. These engines will be complementary to and in some cases competitive with the clustered chemical engines. More important, for space exploration missions such as interplanetary flight they will be indispensable.

In particular, the nuclear engine will be required where specific impulse above 100 sec are needed for long range



**PRECISION
for top-flight
performance!**

Rigid Pratt & Whitney Aircraft precision design—excellent performance... top-flight performance. Reason: The future is at stake. And that future can well ride on gas turbo. Since 1940, Pratt & Whitney Aircraft gas turbines have been Proven's standards... for commercial gas as well as aircraft. Each precision part all is longer wear, greater efficiency, lower maintenance cost. This type of precision can pay off for you, too.

Turbo Pratt & Whitney Aircraft J57 in F-100, power plant for Air Force "Sonic" guided missile, is proved for both commercial and military performance by Proven. Typical installations on Proven J57s: 1950-1955 1000 to 2000, 1955-1960 2000 to 3000, 1960-1965 3000 to 4000, 1965-1970 4000 to 5000, 1970-1975 5000 to 6000, 1975-1980 6000 to 7000. More Proven gas are enhanced, hardened and ground



PERKINS
MACHINE AND GEAR CO.

Dept. 111 West Springfield, Mass.
Telephone: REpublic 7-0751



The new long look



Test Equipment designed and built by Hughes El Segundo is an replacement on the Hughes Electronic Avionics System which it tests



His job is the cockpit. Wherever Hughes systems and manin are employed, Hughes Field Engineers are on hand to work directly with squadron personnel.

in sky scanning

A totally new idea in reconnaissance radar, SEARCHER (at left) is a side looking, microwave search antenna within a completely self contained detachable pod. Carried under the Convair B-58 Super Sonic Bomber as a 50 foot package, SEARCHER has all hardware and black boxes built-in. It is roll stabilized—when the aircraft changes flight attitude, the antenna maintains its normal aim.

SEARCHER was designed and developed by the Microwave Laboratory of Hughes. This Microwave Laboratory is presently engaged in every field of electronics for airborne, mobile, communication, and ground and ship-based radar systems—with operational ranges from 50 to 70,000 megacycles.

The "systems orientation" represented by the new SEARCHER reflects Hughes philosophy of integration. The Microwave Laboratories, for example, support the Systems Development Laboratories as well as the Hughes Ground Systems Group in Fullerton.

Advanced Research and Development at Hughes creates stimulating opportunities for creative engi-

neers in Airborne Electronic Systems, Space Vehicles, Planets, Nuclear Electronics, Global and System Communications, Ballistics, Missiles and many others.

Similar opportunities exist at Hughes Products, where basic Hughes developments are translated into commercial products—semiconductors, specialized electron tubes, and industrial systems and controls.

From basic research through final application, Hughes offers a unique opportunity for personal and professional growth.

Many current programs at Hughes have moved immediate openings for persons experienced in the following areas:

Digital Computer Eng.	Communications
Microwaves	Radar
Semiconductors	Circuit Design
Field Engineering	Systems Analysis
Microwave & Storage Tubes	Reliability Engineering

Write in confidence, to Mr. Tom Stewart,
Hughes Ground Office, 844 Hyde, Culver City, California.

© 1965 HUGES

The Field Index is advised ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY
Culver City, El Segundo,
Fullerton and Los Angeles, California
Tucson, Arizona



FASTEST TUNING PULSE MAGNETRON TUNES HYDRAULICALLY

adapts to current systems

This is the first pulsed magnetron of the first hydraulically-tuned pulse magnetron. It permits a powerful new capability in auto-tuning pulse-to-pulse frequency diversity operation.

Designated L-3211 and equipped with an hydraulic tuning mechanism we developed, this is the fastest tuning, narrow power magnetron in production today.

The L-3211 is designed for X-band operation with electrical characteristics similar to those of our standard 500 power 6543 magnetron. The principles of its design make it adaptable to other power levels and frequency bands.

Tubes of this family greatly enhance system

tuning capability, spreading that of voltage-tuned tubes, with much greater efficiency and less system complexity. The L-3211 affords a means of supplying both new and existing radar systems in operational effectiveness. (We also can provide information on a "modification" basis on classified tubes that have even greater capabilities than the L-3211.)

In constructing the L-3211 we use variable technology proprietary with us — techniques which guarantee a long operating life and a long shelf life. Available prior to full-power operation in emergency.

It is another one of a large number of instruments taken used in radar and communications

units to specifications established by Litton Industries — specifications which have become accepted as standards by the military services.

Our Applications Engineering Lab is well equipped to analyze your problem. It has been consistently successful in finding fast and accurate solutions to difficult system problems. Let it solve yours. We'll be glad to answer your specific inquiries, or to send you a copy of our catalog. Litton Industries Electron Tube Division, Office A2, 983 Industrial Road, San Carlos, California.

*Technically, in our Personnel Department.

LITTON INDUSTRIES Electron Tube Division

MAGNETRONS • GAS DISCHARGE TUBES • CATHODOSCOPE • TRAVELING WAVE TUBES
KLYSTRONS • BACKWARD WAVE OSCILLATORS • NOISE SOURCES • DISPLAY TUBES

CAPABILITY
THAT CAN CHANGE
YOUR
PLANNING



General Electric Co. has developed a simplified process for locating space seats to fit the individual pilot. Above, technicians of Maize and Space Vehicle Department prepare pilot, who is clad in a space suit and covered by chains and fast, for a plastic cast. That has removed a portion similar to a fitting position. After the cast is removed, it is filled with a hard epoxy resin.

General Electric Space Seats Fitted to Each Pilot



Epoxy cast is added over the pilot. Epoxy resin assumes contour area configuration.



Epoxy mold is placed over polyethylene form to form the actual pilot seat.



Polyethylene cast is post-cured at 200° for two hours, then is machined to a molding of a space seat (above).

CASE HISTORIES



Preloading of the New Departure double row ball bearing eliminates progressive bearing corrosion problem induced by engine vibration.

Photo: Courtesy Warner Electric Brake & Clutch Co.

Preloaded Double Row Bearings Solve Fretting Corrosion Problem In Electric Clutch!

CUSTOMER PROBLEM:

Fretting corrosion of automobile air conditioner electric clutch bearings due to engine vibration. Application requires compact bearing design and positive lubricant sealing.

SOLUTION:

N/D Sales Engineer, working with the manufacturer, suggested replacing two single row bearings with one internally preloaded New Departure Double Row ball bearing with shield and Sinter-Bond. The preloaded angular contact construction of these New Departure offered maximum resistance to combined radial and thrust load deflections, plus freedom from

effects of engine vibration. Problem of fretting corrosion was eliminated by producing bearings with accurately determined internal compression. Lubrication of bearing was assured for life by New Departure's exclusive Sinter-Bond... dirt was sealed out under extremely confining conditions. In addition, the compact size of these double row bearings eliminated a tough assembly problem... and provided savings in both space and costs.

When you're faced with a bearing problem, why not call on New Departure. Chances are there's a precision N/D high production bearing that will solve it. For more information, write Department G-2.

Available through United Motors Stores and its Independent Bearing Distributors.

NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NEW DEPARTURE BEARING LINE & BALL

MISSILE ENGINEERING



AZUSA launch pads of Cape Canaveral, Fla., are loaded with missiles to create of AZUSA army launchers.

AZUSA Is Precise Aid for Range Safety

By Richard Sweney

San Diego—An electronic watchtower which tells the stage safety officer exactly where a ballistic missile would land if its power failed completely, and predicts where the nose cone will fall after a several flight is contributing to development proving at Air Force Missile Test Center, Patrick Air Force Base, Fla.

Known as AZUSA, the system was developed by Alexander Drexler of General Electric, and its accuracy is of the order of a few parts per million in case of the diversion angle for azimuth and small increments of first flight distance, with both accuracies available in real time.

System's Value

System's value is such that deflection of it is normal and is in the Atlas program of Army-Air Force.

Since facts about AZUSA are:

- It has been used successfully on even ballistic missile forms at Air Force Missile Test Center, according to General.

- It is considered as an essential part of range safety equipment in very few cases, which results have been allowed in it if AZUSA was impossible.
- Precision is so high that AZUSA is used as guidance system evaluation instrumentation.

The greatest use of AZUSA today is at Cape Canaveral where, at a range safety device, the system has a high

precision for missile launches, further enhancing the system's standing in battery while having field.

Originally AZUSA was considered as a possible guidance system for Atlas as a backup to the General Electric system now in use (AW- April 24, p. 74) rather than as an impact predictor.

As a backup, Atlas for AZUSA are constantly being expanded and a second generation system called AZUSA II now is coming into being. Basic system is capable of being expanded in many directions and General Electric engineers believe it can consistently at work in this area.

Heretofore of AZUSA, general Electric was for missile launch system could land a missile in the room with today's equipment somewhat more field.

Additionally, AZUSA could be used in following with data being sent to AZUSA center with proper ground station locations. AZUSA also could be used on new cones to send back accurate data, not as a part of the impact predictor system.

Designer-User Cohesion

AZUSA is designed built, modified, operated and serviced by General Electric, resulting in advantages such as design-engineer cohesion which might not be obtained if one party designed the system, another operated it and a third still another serviced it. Three are General Electric, but AZUSA is basically an intercom-

puter for missile launches, further enhancing the system's standing in battery while having field. Originally AZUSA was considered as a possible guidance system for Atlas as a backup to the General Electric system now in use (AW- April 24, p. 74) rather than as an impact predictor.

As a backup, Atlas for AZUSA are constantly being expanded and a second generation system called AZUSA II now is coming into being. Basic system is capable of being expanded in many directions and General Electric engineers believe it can consistently at work in this area. Heretofore of AZUSA, general Electric was for missile launch system could land a missile in the room with today's equipment somewhat more field.

Ground Antennas

The ground antennas, located in numerous plastic enclosures, are positioned along two borders that are usually perpendicular and form a short cone. This, however, direction angle comes with two outer bearing (or) portions of antennas providing line data which exact location (or) range data, to missile antennas.

United States Coast & Geodetic Survey located antennas with an accuracy of 21 parts per million. Max size, concrete pads first movement of antenna bases to base ten thousandth of a foot. Half of the Florida sea or rapid construction of permanent arrangements to keep the concrete from expanding, flaring, throwing antennas out of alignment and precise. Missile launching pads all are to



Why the Firebee is America's most used jet drone missile

Ryan Firebees are the most widely used jet "missile" aircraft that have ever been developed. Today they're flying longer, farther, higher, and faster on target missions, and more of them are in flight each day. For example: the Air Force recently launched 44 Firebees in a run which averaged one hour's flight duration each. And 30 of these—many after target "beats"—were recovered for reuse!

Firebees were the only drone used in the Air Force's recent Project William Tell Weapons Meet to evaluate the combat readiness of America's air defense system.



The Ryan role in jet transport

RYAN's role is to engineer and build better power packs, better airframes, better navigation systems—for the aircraft and engine companies that build America's jet planes.

For the Douglas DC-8, Ryan is building huge, position-made pads and pylons to harness and package the jet power that give this jetliner its superb performance.

For the Boeing KC-135 jet tanker-transport, Ryan manufactures massive 40-foot-long fuselage sections—the first double-contoured aircraft structures to be produced under automatic production methods. This technique, developed by Ryan engineers, pro-

vides an aerodynamically smooth structure, fabricated by lightweight methods, that insulate metal fuselages at jet speeds and present them for extreme altitudes.

To meet the needs of global jet flight, Ryan has developed the lightest, simplest, most reliable, most compact Doppler radar navigators. Now in production for military use, these advanced systems will bring unprecedented precision to commercial jet navigation.

Ryan can BUILD BETTER because it is a pioneer aircraft company whose long experience is integrated in all areas of aeronautical research, design, development, and production.

For 5 years Ryan has built rocket motors for Corporal missiles

In 1961, Ryan was given the honor of building the Army's 10-ton Corporal missile to Mach 3 speeds, to drop its atomic blast on a target 100 miles away. And the power must be controlled with pinpoint precision.

Ryan achieves this precision by forming, welding, and machining Corporal rocket motors to laboratory-like tolerances—keeping 30 years' experience in high-temperature metallurgy with productive skills.



DISPLAY panels are set up for language flights, but position is shown on graphics panel of left, sound panel on panel at right.

vided with reference to the center of the AZUSA baseline.

AZUSA frequencies are in the microwave band, and frequency lock technique is employed.

Frequency Shift

At launch the transponder in the missile must be acquired. Once acquired, signals automatically lock onto each other and stay that way. Ground station frequency is allowed to drift to stay locked onto the missile transponder signal so that if the transponder signal shifts frequency, the ground station stays right with it to maintain the locked condition.

Latched on condition is a critical aspect of AZUSA, since frequency misalignment is the means of obtaining where a high order of accuracy.

Station utilizes two alternate principles. Signals are computed on a phase basis. Range is determined by superimposing a series of modulation frequencies on the ground transmitted signal. These are supplied by the air base transponder, and time of arrival is compared with the transmitted signal. Range is accurately determined by the difference in the two signals. Actual modulation frequencies, which are spaced, are used to make data non-ambiguous.

Superimpotence

Effective Doppler shift is utilized in this system. Use of frequency superimpotence is such that:

• One frequency is used to locate the missile within a certain distance, according to wavelength, as usually in a 500 m area.

• Upon this, a second superimposed frequency of shorter wavelength measures the distance to within a particular segment of the first 500 m section, perhaps a 10 m portion.

• Another frequency, with still shorter wavelength, locates the missile transponder within a 10 m portion of the particular 10 m area which

is here within a certain 500 part, and so on, until shorter wavelengths and higher frequencies determine the portion down to the "microns of an inch" to resolve the distance ambiguity.

As the antenna is actually located on the missile airframe, there is no question as to whether a signal is reflecting back from near area, mis-



ACTUAL location of missile with reference to cross range and altitude is shown on panel

RYAN BUILDS BETTER

AIRCRAFT • POWER PLANTS • ELECTRONICS
Ryan Aeronautical Company, San Diego, California

PIONEERS OF THE THERMAL FRONTIER

Eastern
COOLING ELECTRONIC
SYSTEMS FOR MISSILES

Monsanto

NEW FLUIDS FOR THE MISSILE AGE

MISSILE
PERFORMANCE

Boost

with more compact, lightweight hydraulic components, cooling and refrigeration units



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.



FASTER ... automatic systems will not fail. Improved performance is a result of the compact, rugged design for long-range, high-altitude flight. The system is designed to operate at altitudes to 40,000 ft.



FASTER ... automatic systems will not fail. Improved performance is a result of the compact, rugged design for long-range, high-altitude flight. The system is designed to operate at altitudes to 40,000 ft.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.

Smaller components pay off in higher performance ... savings in weight and space add up to hundreds of additional miles per hour — or miles in range.

Eastern Industries' missile components and systems are manufactured to meet the most rigorous requirements in space and weight. Through the use of Monsanto Coolanol® 45 and miniaturization concepts, Eastern now makes it possible to design more power, more performance into less and less volume and weight.

Airplane Cooling with Coolanol 45: The Monsanto-produced fluid is the answer to heat problems associated with miniaturized electronics — extrinsic operations in situations where air cooling is impractical. Having a high boiling point, Coolanol 45 permits "hotter," smaller systems than with water cooling; low flammability tendency guards against circulation troubles. Heat transfer characteristics and dielectric properties of Coolanol 45 are excellent over its —65° to 400°F temperature range.

Hydraulic Pumps and Coolanol 45: Eastern puts Coolanol 45 to double use—as a hydraulic fluid as well as a coolant. The higher pump speeds possible (up to 24,000 rpm) mean more efficiency, result in smaller units for any given job ... and prolonged pump life is the result of the fluid's excellent lubricity.

For deep forays into the thermal frontier — for problems in system redesign or miniaturization — for innovative solutions — turn to Eastern Industries.

*Coolanol, Monsanto Trademark.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.



POWER ... Eastern electronic tube cooling units and systems permit reliable operation of all tubes, which run hot and fast. The cooling unit allows missile launchers to fire at altitudes to 40,000 ft.

MONSANTO CHEMICAL COMPANY
Aermet Fluids Dept. AV 15
Louisburg and Olive Street Roads,
St. Louis 24, Mo.

EASTERN INDUSTRIES, INC.
100 Bell Street
Hudson 14, Conn.

FERRARA



FIRST LOW-COST SPACE AGE AIRCRAFT DEMONSTRATES NORAIR SYSTEMS MANAGEMENT CAPABILITY

The twin-jet T-38—America's first supersonic trainer—aptly demonstrates Norair's capability in systems management. Now in production under USAF contract, the T-38 Talon is the first member of a Northrop-conceived family of lightweight, low-cost space age aircraft.

Soon to follow: a supersonic countermeasures fighter, the N-360—first weapon system designed in America for the specific tactical and economic requirements of those low-flying nations most vulnerable to enemy attack.

Other important systems management achievements include the USAF Scout SM-62A and the F-89 Scorpion. Norair management of the Scorpion program produced the free world's

first operational intercontinental guided missile—delivered on time and at minimum cost.

In producing America's first nuclear-armed interceptor, Norair's weapons systems management of the F-89 was marked by on-time delivery of more than 1,000 units throughout the program's life, and by a significant dollar overrun. A full ten years after its first flight, the Scorpion is still the USAF's most heavily armed interceptor—and a uniquely stable platform for air-launch of atomic rockets.

Norair's cost-pressed record of effective management, integrated facilities, and available resources continue to demonstrate outstanding capability as a prime systems contractor.

NORAIR formerly Northrop Division
NORTHROP, CALIFORNIA
A DIVISION OF NORTHROP CORPORATION



AZUSA intercepts is purified in order, repeats most of calculation sequences for range determination.

whereas in propulsion system of the missile.

With the direction angle course already determined as well as range, the position data is fed into the IBM 704 computer which is part of AZUSA to derive velocity and acceleration.

Plotting Circuit

Information comes out of the computer in real time, and goes directly to a plotting board on which a trace pen is controlled for range and course. Geometry which translates the course into coordinates, and a major effort in AZUSA development. Realities have to where the course would impact if threat terminated in steady, i.e., it does not then when the missile itself is at the moment, either where it would head if threat terminated, which is the impact prediction.

Additionally, there is a report in AZUSA system ahead of the computer and digital output, which generates missile actual position as real time. An IBM 704 computer is being used for AZUSA system, which will be able to accept the output of two AZUSAs and an FPS 16 radar simultaneously. Basically, the 704 is a 704 which can handle more inputs.

Practically, the impact predictor needs to derive calculation only during the threat and controlled portion of the flight, since a hybrid trajectory for more time leads true time that point to impact.

When an impact prediction is given by AZUSA in real time, impact point actually is within a CEP (Circle of Probability). If AZUSA data type is "smoothed" and runs through the computer several times, also cross-smoothing and cross, CEP is considerably reduced. Actual diameter of the best observable CEP is classified, but acting on smoothed AZUSA information, the smaller than reported range comes has been spotted by air craft.

Two other instances of AZUSA accuracy, in combination with other factors such as highly accurate missile



MIL-SPECS A GUIDE, NOT A GOAL

With approximately one thousand Military Specifications covering details of design, manufacture, and test of a military system and its components, it is striking to realize that, even by conservative estimates, over 80% of them are currently obsolete because of significant advances in the "state of the art". It is illogical to assume that Specs can be kept current, as view of the enormity of this task.

A heavy responsibility is imposed upon our industry because Mil-Specs lag so far behind the latest manufacturing technology and the stringent demands of the missile program—some of which are yet unknown. Reliability must be a consideration in the design of electronic components, to a degree far beyond that specified by those outdated Specs... It must be the ultimate attainable with the best current production techniques.

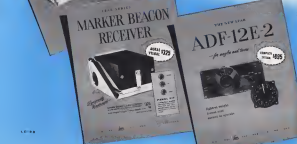
Keeping precision components ahead of requirements is the greatest contribution any manufacturer can make toward solving this problem. Failure to recognize the accuracy of producing the ultimate reliability possible can only result in inferior system performance, and tremendous loss of time and money.

Quantitative reliability must be the primary concern of management, designers, engineers, and production personnel. We must make a concerted effort to obtain 100% reliability in each and every item. This means our research and development effort must: 1. be channelled along lines which constantly evaluate products in terms of operational performance, and 2. take advantage of every breakthrough in materials, design and manufacturing.



George J. Pardipis
President

ELECTRO TEC CORP.
P.O. BOX 870, GAITHERSBURG, M.D.
Products of Precision Craftsmanship



ORDER NOW
for early delivery!

LEARCAL DIVISION
3111 NORTH HIGHWAY 100 • SANTA MONICA, CALIF.

LEAR

lights were two arrows in which one color was actually used during events. One was the pilot of a search plane, and the other occurred late last December when both the search plane pilot and the personnel of a Navy ship died in a crash.

Airborne transponder for AZUSA weighs 59 lb presently, but is less than 5 lb and will be reduced to 20 lb for installation on select propeller-driven. There is USAF qualified and has passed the road specifications for such equipment.

AZUSA transponder, which has been on about 65 aircraft, including F-4s, is not critical as to location in the vehicle, but it can be mounted even from the interior. Chalk and white is located at the antenna so that line of sight will obtain between ground station and antenna through wet powered and controlled flight period. However, General has been able to install the equipment on an aircraft in a fairly standardized location.

Hycon Manufacturing Acquires Metals Firm

Dallas-Hycon Manufacturing Co. has acquired control of Gulf Industries, Inc. and will open its Texas metal-working company as a wholly owned subsidiary. The acquisition will broaden Hycon's operations by providing a manufacturing facility for its aircraft test equipment business.

Forrest Gardner, Hycon president and board chairman, said it is the first step in a planned expansion program to broaden the company's scope of activities and strengthen basic Gulf Industries products and services and plans and plans to expand its activities in that field.

Sealant Maintains Q-5 Hull Pressure

Internal hull pressure of 25 psi, necessary for successful operation of the Lockheed Q-5 Kingfisher target aircraft, is maintained with high temperature stress sealant. The removable one-part sealant reaches in-flight temperatures of 500 to 700°F. General Electric RTV-60 sealant is applied to the entire hullings of the Q-5 to reinforced both internal and external pressure. Leakage requirement of less than 2 cfm, which was exceeded by organic sealants, is met by the silicone system, Lockheed reports.

Cost of the silicone sealant is about \$170 per ounce as compared with approximately \$2,000 per unit for the organic material. Cost saving is realized by simple methods of application and faster curing time (24 hr) of the RTV-60 sealant.

Introducing Wyandotte's new

BUZZ

MODERN PAINT REMOVER

BUZZ IS VERSATILE! Apply it by spray, brush, or flow-on method. Buzz removes paint and releases stains from all aircraft metals. Also ideal for ground support equipment (trucks, trucks, etc.).

BUZZ IS APPROVED! Meets all requirements and has received Air Force approval under NLR D-55134 (USAF). Designed especially for the new Air Force points.

BUZZ IS SAFE! Non-flammable. Non-corrosive. It is based on one of the safest of all chlorinated cleaners — methylene chloride.

BUZZ IS VISCOUS! Adheres to vertical and overhead surfaces. Yet Buzz can be easily removed by rinsing with water.

BUZZ "STAYS WET"! Contains evaporation retarders for longer action. And Buzz contains no abrasive or metallic particles. For more details about Buzz—or information on Wyandotte's other aircraft-cleaning products—call your Wyandotte representative today. Or mail coupon below. Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California. Office in principal cities.



Wyandotte CHEMICALS

J. B. FORD DIVISION

Specialists in Aircraft-Cleaning Products

***** MAIL COUPON TODAY! *****

Wyandotte Chemicals Corporation, Dept. 3150, Wyandotte, Mich.

Please send information on:

- | | |
|--|---|
| <input type="checkbox"/> Paint Removal | <input type="checkbox"/> Removing Release Stains |
| <input type="checkbox"/> Aircraft Cleaning | <input type="checkbox"/> Chemical Products for Aircraft Maintenance |
| <input type="checkbox"/> Bleaching | <input type="checkbox"/> Aluminum Cleaning and Brightening |
| <input type="checkbox"/> Corrosion Control | <input type="checkbox"/> Bore Treatment |
| <input type="checkbox"/> Metal Cleaners | <input type="checkbox"/> Chemical Milling Abrasion and Regeneration |

Name _____ Title _____

Firm _____

Address _____

City _____ State _____



Photo of an official flight test of AN/USQ-2 drone, U. S. Army Test Center, Fort A. Johnson.

MISSION ENSURED

with a reliable RHEEM drone system

From launch to touch down, a RHEEM drone can be counted on. Behind every RHEEM drone system is the rich accumulated experience of hundreds of engineers and technicians skilled in sensorization, electronics, and ordnance. Backing up this talent are thousands of the nation's best production workers.

Typical of RHEEM capability in the design and production of complete drone systems is the U. S. Army Signal Corps Project, the AN/USQ-2. From initiation to successful flight test, this surveillance drone project was accomplished in just twelve months at the Downey, California, plant of the RHEEM Defense and Technical Products Division. RHEEM ingenuity and know-how provided not only the drone airplane but also important components of the telemetering and ground support systems.

For combat surveillance or high-flying air-to-air targeting . . . for anti-submarine warfare or anti-ship defense training . . . whatever the requirements, consult RHEEM for reliable drone systems that can be brought to reality in less time than you would think possible.

For more information on RHEEM drone systems, write for Data File AW-T04-2.

RHEEM MANUFACTURING COMPANY
Defense and Technical Products Division

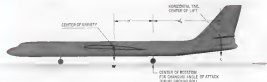
11711 Woodcraft Avenue, Downey, California



Engineer John Brown in advanced drone systems work.



AERONAUTICAL ENGINEERING



MAJOR design problem with large aircraft that have quadric or biplane landing gear has been the location of the main wheels in the fuselage. Most location is to have the main gear put behind the center of gravity. In this situation the moment of the horizontal tail lift about the rear wheel (B, C & D) (above) is a minimum and the pilot can use the nose of the aircraft at low speeds during the ground roll. It has been possible to have the favorable location of gear in main cases and the horizontal tail gear has not been sufficient to use the aircraft's nose when the wheels were at the ground. The Russians have overcome this problem in some cases by using a very low length strut on the base wheel (below). The pilot has moved over the length of the strut which then gear has moved over the angle of attack during takeoff run.



Soviets Design Adjustable Landing Gear

By J. S. Bate, Jr.

Washington—Pilot of certain Russian high performance aircraft appear with control the angle of attack during takeoff ground roll by varying the length of the landing gear struts over the horizontal tail is sufficient.

This arrangement is used to overcome the ground roll longitudinal control problem as some Russian aircraft that must use conventional landing gear and have the main wheels on the fuselage with small outrigger wheels under the wings. On some of these designs, including the Russian interceptors, because it has been impossible to place the rear landing gear as well as the disposable load position, loads are near the center of gravity.

Therefore, the rear wheels have been placed much further aft at the center of gravity than on conventional inside rear aircraft with the main wheels in the wing. This aft position of the rear wheels in some instances has made it

unusable for the normalised low speed roll to lift the nose of the aircraft while the landing gear is touching the ground.

Use of the variable length landing gear struts and the design problem associated with aircraft wing quadric gear have been discussed in detail by Colonel Fyodorov N. L. Lyubov, and E. Mikheyev in the Soviet air force magazine, *Soviet Aviation*.

Conflicting Requirements

One of the first problems noted by the Russian engineers is the proper aircraft angle that the wing should have with respect to the longitudinal axis of the fuselage. There are two conflicting takeoff requirements that affect the setting of this wing incidence angle: especially on an aircraft with quadric landing gear. They are:

- Angle should be low to allow the aircraft to accelerate to takeoff speed in a minimum distance.
- Angle should be high so that the

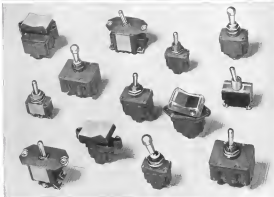
movement lift coefficient is achieved during ground roll, and the aircraft does not lift, to reach a high speed before enough lift is developed to take off.

On most landing gear struts these contradictory requirements are noted because the pilot can control the wing angle of attack with the horizontal tail. He can hold the nose down until he reaches takeoff speed and then raise it to develop maximum lift and keep takeoff distance to a minimum.

There are a number of possible reasons for these takeoff requirements when the horizontal tail is sufficient. One of these is the variable incidence wing which is used in the Russian Yakovlev aircraft on the YSU. In this case, lift over the variable incidence wing was used primarily to improve pilot visibility.

The Russian approach to the problem as it applies to very large aircraft was described by Luchko and Mikhovskaya when said the design was a 1.5

H MICRO SWITCH Precision Switches



Toggle and rocker actuated switches that provide better answers to a variety of switching problems

This group of thirteen switches represents well over seven hundred switches in three series. There's a complete selection of contact arrangements, mounting provisions, and choice of single, double, or 4-pole constructions.

"TF" Series—rodless actuated, sealed actuator and cover. Available with translucent keys for use with edge hybrid panels to give visual indication of position, or with translucent keys that permit inspection of labels. Integral terminals. These switches promote neat panel appearance. Data Sheet 141.

"TL" Series—toggle switches with sealed actuator and cover. Most Specifications MIL-G-3850A. Integral terminals. Dailyly phosphate cases reduce carbon tracking at contacts, and minimize contact arcing. Series includes pull-to-rotate toggles, with a positive lever lock that requires a definite pull to change toggle position. Knobbed lever variant use with gloved hands. Data Sheets 139 and 140.

"TR" Series—toggle switches that meet Specification MIL-G-3850A and, in addition, offer outstanding features. Sealed toggle lever. Riveted solid

alloy contacts. Maximum over-center coverage and clearance distances. Momentary versions are built without return springs in order to eliminate a source of early failure. Described in Catalog 33—which also includes extensive and comprehensive toggle switch assemblies.

All these switches are manufactured with extreme care and precision from the finest materials, with due regard for important details that mean easier mounting and wiring, and longer switch life.

Send for Data Sheets and Catalogs listed above. Engineering assistance on switch applications is available from the MICRO SWITCH branch office near you.

MICRO SWITCH . . . FREEPORT, ILLINOIS
A Division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 15, Ontario



Honeywell
MICRO SWITCH PRECISION SWITCHES

angle (quadrants) loading gun had to effect also on the other aspects of the airplane design. Due to the considerable distance between the struts, even in the case of a large wing incidence angle, the resultant ground angle is not great and at the same time is equal to the wing angle. This angle is so small that the lateral speed would have to be too great. Consequently, it is necessary to increase the angle of attack in order to decrease the speed needed for takeoff in the case of a heavy airplane with such an arrangement of shock landing gear, this is difficult to achieve by means of elevation.

"It would be possible, of course, to increase the ground angle by lengthening the front strut. However, in the case of airplanes with low thrust power, the lateral run with maximum acceleration that takes place with the so-called optimum angle of attack, which is always small. In the case of these airplanes, it is expected to increase the angle of attack when the takeoff is over has been obtained. This is accomplished by changing the lengths of the landing gear struts during the takeoff run. When the rear struts are retracted, it could be means of a method known as 'gearing,' in the front struts are lengthened, i.e. the airplane is reared up.

Rearing up takes place at the moment when the front strut is retracted to the lift force and consequently there is no need in powerful motors for this mechanism. Squinting of struts also does not entail the use of high-pressure motors and at first glance it even seems advantageous than rearing. From the safety angle, however, in the retraction of struts with doors are installed on the front strut assembly since it carries a heavy load during starting and accelerating runs."

U. S. Practice

Thus, as you note, U. S. aircraft that use quadrangle landing gear—the Boeing B-47 and B-57 bombers. A different lateral technique is used on each of these aircraft because the fundamental arrangement of their landing gear is different. Neither of these techniques resembles the Russian practice of using a variable length landing gear strut.

Rearing negated the B-47 wing of a conventional aircraft because that by increasing ground run acceleration and maximum lift coefficient. The horizontal tail is relatively ineffective during ground roll because the rear section of the main gear is so far aft of the center of gravity. Landing gear for a B-47 bomber, in spite of its rearing, is unable to accelerate the aircraft faster than the main tail is capable of doing speed and lifts itself into the air.

The forward and aft sections of the



You Get MORE POWER—Less Weight with the New CHERRY G-85 Lockbolt Gun

The new Cherry G-85 lockbolt gun is designed to give you maximum pulling power with less weight. Its simplified rugged construction assures low maintenance costs. The gun weighs only 10.5 pounds, which reduces operator fatigue.

No special air supply is required with this lightweight gun, because it develops the high capacity at normal line pressure.

As the leader in the field of special aircraft fasteners, Cherry Research

and Development department has produced this new lightweight, high capacity gun to increase the efficiency of installing lockbolts.*

The G-85 gun may be adapted for setting stainless steel, monel, aluminum and carbon steel Cherry blind rivets.

For information on the new Cherry G-85 gun write Townsend Company, Cherry Rivet Division, Post Office Box 2157-N, Santa Ana, California.

CHERRY RIVET DIVISION
SANTA ANA, CALIFORNIA
Townsend Company
ESTABLISHED 1915 • NEW BRITAIN, PA.

5,000 digital instruments now in use!

DC INSTRUMENTS—A four or five digit Bridge Module combined with a Power Unit Module provides precise accuracy of 0.001%. The base 100-microamp sensitivity can be extended to 1 microamp with the new low level DC Amplifier Module.

AC INSTRUMENTS—Time stability and zero economy because of the precise E-I module concept. For AC measurements with 0.1% accuracy, add the AC Converter to your DC instrument. No calibration or zeroing plug-in cables and get the AC/DC Digital Instrument to drive display unit.

DATA HANDLING SYSTEMS—Expand your basic instruments of expense to provide the measurement of voltage, current, electric resistance, time, angle or multiple sensors, with E-I Subsystems, Elements and Scanner Modules.

OUTPUT CONTROL—In addition to the illuminated read-out for operator readout, E-I systems provide contact closure which completely define the measurement, and the signal channel, E-I manufacturers a complete suite of Print-Control Modules to process data for screen or peripheral in parallel, parallel type, punched card and electric typewriter data transfer.

STORAGE, TIME, PROGRAM—The E-I line includes off-the-shelf modules for data storage, time base and programming facilities.

TOTALLY TRANSISTORIZED
for consistent performance, reliability and accuracy. E-I equipment and systems reflect the maturity of manufacturing and production know-how of the leader in the digital instrumentation field.

WRITE FOR COMPLETE SPECIFICATIONS

The complete line
of digital instruments

Electro Instruments, Inc.

8850 Aero Court, San Diego 17, California

man leading you down the ground measurement, and the pilot cannot see the nose until the aircraft is flying.

One major flying objective in this design was to have the B-47 takeoff with steep climb speed to reduce the danger of stalling the aircraft during the climb out. The high wing loading of the B-47 made this feature attractive from a safety viewpoint.

The B-47 landing gear arrangement is more conventional, but it was possible to place the main section of the main landing gear just aft of the center of gravity. The horizontal tail is effective at speeds well below the take-off speed, and the pilot is able to use it to raise the nose of the aircraft and take off in the same manner as aircraft with tapered wings. Wing loading of the B-47 is less than that of the B-47 under maximum gross weight conditions making it easier to fly in some respects despite its greater size.

Flying Problem

There is a major flying problem with an aircraft that has collective elevators during the takeoff ground roll because the pilot has no "feel" through the longitudinal control system. The situation is more acute when a variable length landing gear struts are used to control angle of attack in the Russian method than in designs such as the B-47 that fly themselves off the ground.

The problem for the pilot is that when he leaves the runway he has no accurate means of knowing whether the aircraft will be trimmed out for flight without making it be sighted by the elevators in such a position that the aircraft will go into a sudden climb or dive as soon as it becomes airborne.

Slight variations in the aircraft's loading which are difficult to determine plus the lack of feel make it virtually impossible for the pilot to know exactly where to hold his control columns so that the aircraft will enter a smooth climb when it wheels down the ground to the Russian system, the pilot not only has to consider his loading but must take into account the angle of attack that he has set with the variable length landing gear strut. If the horizontal tail is not set for the same angle of attack, the aircraft will either dive or climb sharply as it left the runway.

Kayenta and Mikeshtunas described this problem during "The main topic is characteristic of the design use of a heavy airplane equipped with variable length gear in the middle as the part of the pilot to feel and control the plane's longitudinal position. Upon leaving the ground the airplane may develop a tendency to increase or decrease the angle of attack. Without a way to take place when the airplane is airborne, the pilot cannot become accurate by means of his senses as he enters

WHAT SQUARES CAN YOU FILL IN THIS R & D MATRIX?

	RESEARCH	ANALYSIS	DESIGN AND TEST
Basic Systems			
Basic Data			
Basic Methods			
Basic Subsystems			
Basic Materials			
Basic Processes			
Basic Equipment			
Basic Facilities			
Basic Personnel			
Basic Management			
Basic Economics			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			
Basic Transportation			
Basic Energy			
Basic Environmental			
Basic Safety			
Basic Security			
Basic Communications			

HADLEY missile valves & controls



OUT OF THIS WORLD!

Congratulations to ARPA, the USAF and CONVAR (Astronautics) Division of General Dynamics Corporation for the successful launching of Atlas Project SCORE.

Hadley is particularly proud to have contributed to this wonderful accomplishment which is literally "Out of This World."

Pictured here are some of the valves and controls designed, manufactured and qualified by B. H. Hadley, Inc., for the Atlas. For more information, write J. T. Reilly, Director of Marketing.



Flowers in Cryogenic Valves

B. H.

HADLEY INC.

POMONA, CALIFORNIA

Dynamic Solenoid Valves

High Performance Medium Check Valves

Medium Pressure Ball Valves Liquid System and Fuel System

Quick Disconnect Couplings Pressure & High Temp. 1/2", 3/4", 1" & 2" diameter

Valves Pressure 1000 psi to 1000 psi Temp. 1000°F to 1000°F

Dropout Ball Valve 1/2", 3/4" & 1" diameter

in the atom on the control stick. Consequently, the position of the control lever, the balance is pre-adjusted by wind turned zero in during the process of test run, while the pilot is given instructions how to hold the controls during the takeoff run. However, the position of the control wheel must be checked with the change in balance, the value of angle of the flap and, in general, with consideration of everything that affects the longitudinal moment of the airplane. Thus, the pilot will have to make his own adjustments during the flight.

Maintaining Direction

Some other aspects of handling these large X-5 aircraft and some of these equipment also were described by the two officers who said:

"During the ground run of an airplane, equipped with hydraulic landing gear, the maintenance of direction cannot be accomplished by a separate landing of the wheels. The officer, even during the second half of the starting run, also cannot turn the plane when the speed is relatively great.

"Consequently, the direction during the starting run is maintained by turning the front wheel manually. Such a method of control is very effective but risky in the case of partial braking. If the front wheel were to be completely locked, the friction sliding force would be in the same direction as in the case of the rear wheel manually, and there would be no turn. I still believe power is not usually applied in a quick as it is in a rapid turning out of the track. In the majority of cases special automatic devices are used which regulate the intensity of the brake operation."

Pioneer Aviator H. M. Berry Dies

Sen. Ross Clark—Homer M. Berry, 44, former chief test pilot for Bell Aircraft Corp. and an aviation pioneer, died tonight with Rep. Gen. John Mitchell and Sen. William H. Harrison. He had been in the U. S. Air Force since he had been a young officer for the Office of Civil Defense Mobilization at Santa Clara. Col. Berry was a Navy bombardier pilot test commander in Africa, Italy and the Far East during World War II.

Swid Aboute to be Built Under License by Swab

Swab Aircraft Co. of Sweden will build the Swid Aboute helicopter under license with initial production set for this spring. First group of 15 will be assembled with parts made in Sweden. Swedish-made parts will be used in later models. Aircraft will be built for Royal Swedish Air Force and Navy.



Photo courtesy, Port Authority of New York & New Jersey



Modern military jets have proven Fluro-T (Teflon) hose in a varied service. Now the first new commercial aircraft use this same hose—for safety and economy.

Fluro-T hose, with patented, specially compounded tubes of Teflon, is non-slip—has no shelf or service life limit. Originated by Resistoflex, Fluro-T was the first Teflon hose and it has been flying for five years on all types of jet and reciprocating engines and aircraft. It is available with compression-type fittings or "Quick-Loose" reusable fittings.

Aircraft specify the hose with highest performance and resistance—not only for safety's sake, but for savings as well. Send for details Write Department 214, RESISTOFLEX CORPORATION, Roseland, New Jersey. Other Plants: Burbank, Calif.; Dallas, Tex.

*T.M. Pat. No. 2,822,728

Fluro-T is a registered trademark; reg. U.S. pat. & © Resistoflex is a trademark of Resistoflex Corporation.

Resistoflex is a registered trademark of Resistoflex Corporation.

Resistoflex



New accessory permits Genisco C181 Rate of Turn Table to be operated at any angle from horizontal to vertical

Prod Descript, Lockheed radio-aider technician, tests pitch-yaw gyro used in the Electro, Lockheed's first, new prop, on the first reliable Genisco C181 Rate of Turn Table.

A new, vertical-drive accessory permits the C181 to operate in any position. Now, gyro or complete gyro packages can be tested at any angle up to 90° from horizontal, either side of center, without changing the test set-up.

With the accessory installed, overall performance of the turntable is unaffected by its position. Rotation is infinitely variable from 0-41° to 180° per second. Continuity of angular velocity is within 0.1%, including wear and drift errors.

The new vertical drive accessory can be installed at the factory, and is also available in kit form for modification by users of machines already in the field. The new tilt stand (shown above) provides a convenient method of tilting and accurately positioning the machine at any angle.

Detailed information on both the vertical drive accessory and tilt stand is available and will be sent upon request.

More than 400 Genisco Rate of Turn Tables are now in use.

ACCESSORIES ADD TO ACCURACY AND CONVENIENCE OF THE C181

Braking System—Provides a stop capable of regular deceleration. Particularly useful in ensuring accurate characterization of rate drift and angular acceleration.

Precision Spindle—For use in positioning tests where fine frequency to accuracy or where gyro error may be better than the frequency.

Slip Clutch—Allows table to be stopped by hand for minor adjustments in test package while drive system continues to operate.

Low Rate Reading—For accurate rate indication below 10°/sec.

Mounting Brackets—Available in portable form and the new tilt stand.

Genisco
INCORPORATED



2033 FEDERAL AVENUE • LOS ANGELES 46, CALIFORNIA



Hull assembly of Sikorsky HSS-2 antiturbine water/terrestrial helicopter (Model 565) is under construction at Stratford, Conn. Helicopters above will be used in static tests only. First flight of two turbine-powered aircraft, capable of landing on water, will be in March.

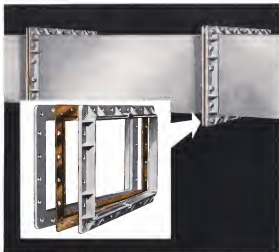
Sikorsky Static-Tests HSS-2 Turbine Helicopter



Early stages of HSS-2 static construction, as seen from left hand side, are shown at left. At right is taken engine looking forward. Power plants are two 1,000 hp-plus General Electric T35-G2-6 turbines, mounted side by side along cabin (AW Sept. 3, p. 46).



HSS-2 engine bay, pilot's compartment, main section, tail cone and tail pylon have been assembled at Stratford. Component below cockpit will house vertical gyro. Landing gear extends into fuselage, shown at right when fuselage is fitted in static test rig.



THESE WR WAVE GUIDE SEALS PROVIDE POSITIVE SEALING; PREVENT R/F LEAKAGE, ARCING & BURNING



Electro-Seals are now available to fit all EIA (RETMA) standard WR series wave guide flanges, WR90 thru WR2300 as well as specials.

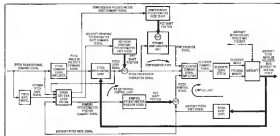
These seals not only provide near perfect sealing and complete electrical continuity, but offer many economical advantages — made by the makers of Parker O-rings, Stat-O-Seal[®], and Gask-O-Seal[®].



Parker SEAL COMPANY

CULVER CITY, CALIFORNIA and CLEVELAND, OHIO

A DIVISION OF PARKER-HANNIFIN CORPORATION



MASSACHUSETTS Institute of Technology system remains of conventional output to which has been added the self-learning control MIT has several input signals to measure performance and drive signals for optimizing their control function.

for vehicles, where surface effects cause can vary over a 10:1 range or greater, the amount of control surface deflection produced by alternate pulses of fuel-amplitude will depend upon control surface effectiveness.

Heart of the Honeywell system is a transducer multi-selector which performs the function of a high speed relay. When the vehicle is being at desired attitude heading, four indicator switches lock and forth, applying brief pulses of energy of alternating polarity to the control surface actuator. This causes the control surface actuator to oscillate back and forth through equal, extremely small displacements on each side of neutral position. In the system which Honeywell will soon test on a McDonnell F-101A, the control surface moves through an angle of only 0.1 deg. at a frequency of about six cycles per second. To prevent this oscillation from causing movement of pilot's control stick, a switch-to-pilot is used for this small loop function.

If the airplane suddenly begins to pitch up, the pitch rate gyro signal feeding back to flight control system will cause the multiselector to dwell longer in one position than the other. This causes a longer burst of energy of one polarity to be applied to the control surface actuator than the pulse of energy of the opposite polarity. This results in a net displacement of the control surface actuator in such a direction as to oppose the pitch-up motion.

This simple basic system will be sufficient for vehicles whose design and flight regime is such that control surface effectiveness does not vary over too wide a range. But for most high-speed air-

craft vehicles, where surface effects cause can vary over a 10:1 range or greater, the amount of control surface deflection produced by alternate pulses of fuel-amplitude will depend upon control surface effectiveness.

Automatic Adjustment

In compensation for this, Honeywell selects the magnitude of control surface deflection, as measured by rate gyro at characteristic oscillation frequency, then automatically adjusts the amplitude of sweep pulses (not their duration) being applied to actuator by the multiselector. Device which compares magnitude of rate gyro signal with a fixed reference is known as an automatic amplitude modulator.

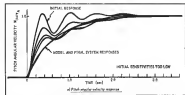
Honeywell's system, like many others described here, employs a three network which is an idealized model (lookalike) of

an airplane or other vehicle which has idealized flying characteristics.

When the vehicle departs from desired attitude or heading, for example, error signal from the reference pin first passes through the idealized model where it is modified and shaped so that it will cause the multiselector to control the actuator in such a manner as to return vehicle to its original attitude at an idealized rate.

Actual rate at which the airplane is returning is compared continuously with the idealized model output and any difference (error) when the signal applied to multiselector, causing it to modify output to actuator so as to cause the vehicle rate to match the idealized rate.

The idealized model also is used to shape a pulse received from the pilot's control stick, an external guidance or



OPERATION of MIT system in adjusting its performance to match idealized model shows system continues to learn of loop gains. Initial response has considerable overshoot, but each subsequent response more closely approaches model.

GUIDELINE ANYWHERE.....

with Motorola hyperbolic navigation systems

From pre-print partitioning of small tactical vehicles in combat areas to critical, repetitive fixes for long-range attack, intercept, ship and sub-surface... Motorola leads the way, following the requirements of the military with precision to emphasis.

Based on low frequency, CW phase comparison techniques, these short, intermediate and long-range navigation systems provide precise position coordinates without line of sight restrictions and with a minimum of contamination from most topographic and man-made obstacles.

Three typical military scenarios under contract to Motorola in the field of hyperbolic navigation are:

PINS—A short-range position fixing system for all types of tactical vehicles and combat personnel. Light in weight, accurate to within feet, this system has been widely-proved under a wide range of environmental conditions.

DRONE GUIDANCE—An intermediate-range system capable of accurately guiding forces around. Positioning data is provided to radio vans* under all conditions of weather or terrain.

RANGE-OMEGA—A long-range, very low frequency system designed to yield fractions-of-a-mile* accuracy on a global scale. Ultra-long, Radio Design models offer world-wide partitioning service for attack, surface vessels and submarines.

Motorola programs have also developed specialized computers, compatible with the above systems, providing instant readout in latitude, longitude, or altitude only. In these units, navigation error is less than 7 yards. Hyperbolic data is translated with a conversion accuracy of 99%.

For specialized* information on Motorola's extensive design advances in the field of hyperbolic phase comparison navigation systems, or for details on current opportunities, write Motorola, Inc., Military Electronics Division, Dept. B, 3301 S. McDowell Blvd., Redwood, California.

*Specific capabilities of these systems can be obtained by properly cleared personnel who contribute a "need to know."



MOTOROLA

Military Electronics Division / CIRCULAR • PENDING • M 1000 10



MOTOROLA

Military Electronics Division



GENERAL ELECTRIC adaptive autopilot uses leading methods to determine whether control atmosphere before actual frequency matches desired frequency. If not, network output signals come into action to operate autopilot which alters control gain.

time before the system reaches the steady-state. Again, the actual complex maneuvering rate is compared with the scheduled value and an difference automatically causes the autopilot to alter the amount of scheduler displacement.

Housewell's studies indicate that the "following error" (reference between actual and scheduled performance) can be kept small if the inner loop natural frequency is at least five to 10 times that of the model. Housewell's David Melles reported.

For inner pilot introduced as good since system demanded maneuvers the system behaves as if it were a basic unit. If, however, the vehicle is suddenly displaced by a double gust, the transient error in the inner loop becomes large and the effective gain is sharply reduced. Melles reported. This he said, is a desirable and necessary feature because it reduces errors changing for external disturbances without compensating system following error for inputs fed through the scheduled model.

General Electric's Gary's approach to a self-adapting autopilot bears some resemblance to Housewell's in the technique used to assess system performance. At periodic intervals a test signal is applied in the form of a square wave pulse to independent autocontrol, into the Spirit self-adapting autopilot.

Revision of the control surface and actuator to this signal is then automatically analyzed and, if necessary, is used to adjust system for optimum performance.

Test impulses may be repeated once every several seconds or less frequently, depending upon the vehicle and flight conditions. The impulse test rate could be speeded up or slowed down automatically depending upon whether vehicle is changing light conditions rapidly or slowly. For example, a track vehicle change of atmospheric conditions could be used to automatically alter the sampling rate.

The test pulse will produce a slight tremor of the aircraft, Spirit's company, which can be perceptible to the pilot in smooth air conditions but probably not during moderate turbulence. However, this was not a completely ac-



Here's how
TECO pulls the
"Stop" on high G's!

Qualifying tests, high-speed film sequences, coordinated maneuvering follow-through and confident commitment in TECO ability have paid off by making available the best safety absorption unit for airline seats.

For complete "How" facts on TECO Energy Absorption, or to see a run-through of the entire technical film—write: TECO, Inc., 2819 Watson Ave., Berkeley, Calif.

TECO Aircraft Seats

Berkeley, California

Stratoflex assemblies help fuel THE MIGHTY ATLAS

Every time a Convair Atlas intercontinental ballistic missile lifts from its Cape Canaveral launching pad, fantastic demands are made of the fueling system and powerplant.

A touch of the blast-off button triggers hundreds of simultaneous chain reactions in the giant ICBM's fuel system. Under tremendous pressure, liquid oxygen is delicately and precisely forced—mixed with a kerosene-like fuel and flashes through the lines as vapor to fuel the four burning in the combustion chamber. This blend, via, few seconds must commence in a split second and continue at tremendous speed if the launch is to be successful. Fuel line plumbing on the Atlas must be absolutely leakproof, immune to strong vibrations, and able to withstand continuous temperature variations.

Despite the infinite possibilities for human mistake and material malfunction, the Air Force, aided by Convair technicians, has successfully launched the Atlas ICBM five after five at Cape Canaveral. (In the spectacular December 18, 1958 firing, the SS-foot Atlas was placed in orbit around the earth.) Stratoflex is proud that its specially-designed "flex" hose and metal tubing assemblies are vital parts of the Atlas fuel line system.

* A Stratoflex trademark.



SALES OFFICES
 Atlanta, Chicago,
 Cleveland, Detroit,
 Fort Worth,
 Fort Worth, Houston,
 Kansas City, Los
 Angeles, New York,
 Philadelphia,
 Pittsburgh, San
 Francisco, Seattle,
 Toronto, Tulsa

STRATOFLEX Inc.
 P.O. Box 10798 • Fort Worth, Texas
 Branch Plants: Los Angeles, Fort Wayne, Toronto
 in Canada: Stratoflex of Canada Ltd.

adjustable characteristics, it gives the pilot a continuous indication that the flight control system is functioning properly. Use of periodic test pulses also makes it possible to include provisions for automatic detection of various malfunctions. Spare pumps on the

Spartan self-aligning autopilot is designed to adjust itself for excessive positive gain which the system builds up with wind drifts and roll maneuvers. To prevent unexpected changes in air frame dynamics from suddenly throwing the system into instability, the meter loop is now damped. Spartan's Stochastic Order tells the computer whether positive gain is adjusted, if required, after each test loopage by a device called a "performance computer" which assesses the number of oscillations of the control surface actuator produced by the autopilot. Test loopage is introduced through a small series valve to prevent an undesirable pull of pilot's control stick.

Performance computer contains digital circuitry for counting the number of control surface oscillations. If, for example, there are three overshoots, the computer slowly decreases system gain through a motor-driven potentiometer. If the count is four or exceeds, the gain is decreased at a slightly faster rate, while the gain would be decreased more rapidly if there were more overshoots. The shaft position of this automatic gain changer is a measure of the relative effectiveness of the control system. In "Down Slow" type space vehicle, this can provide a useful means for determining when it is appropriate to shift switching from automatic to reaction controls, or vice versa, and the relative amount of such needed during transition conditions.

Ring-Ring Control

Because the basic space-loop stable vehicle system is coordinated, coordinated signals from pilot or guidance system calling for vehicle maneuvers must be modified, otherwise the vehicle response would be sluggish. This is accomplished by an electric analog, or analog, of idealized airplane response.

Although the Spartan system employs what is basically a linear amplifier, it includes provisions which make it possible to handle large, non-linear motions whenever the difference between command and actual vehicle response allows an appreciable error buildup. In the glitch-on, for example, this is done by raising the gain dependent upon the instantaneous value of pitch error signal.

The Spartan system also includes what the company calls an adaptive G-limiter which allows system performance as a function of increased vertical acceleration on the vehicle, to prevent the vehicle from exceeding safe structural limits.

The program under way in Aerojet's Spartan Inc., is presently aimed at investigating another technique for assessing performance of flight control system performance. The techniques, described by Aerospace's William Anderson, focus some accelerations to the Spartan approach, test operates continuously instead of periodically and should eliminate any vehicle losses due to periodic test impulses.

Automatic substrates, a white noise signal whose energy is distributed across a wide spectrum of frequencies. The white noise is superimposed upon stabilization, after command signals that may be present in the flight control system. The response of the control surface actuator to the white noise, is put in test mode to cause disturbance of the system, but can be removed by a variable sensitive detector. This output, or response, is cross-correlated with the input noise signal that produced it.

Cross-Correlation

From such cross-correlation, Aerojet experts try to be able to determine the system damping ratio, which can be compared with ideal value and difference used to operate automatically a damping gain adjusting potentiometer. Smaller values can be obtained for all other frequency response and system sensitivity.

Company plans to evaluate a change in flight tests of a stability experiment aboard a North American T-28C this spring, Anderson reported. What now will be produced in a human flight simulator that is controlled by a computer.

MIT Approach

The self-aligning autopilot developed by Massachusetts Institute of Technology's Instrumentation Laboratory and flight tested on a Lockheed F-94C, differs from the system previously described in that it does not require use of test signals or correlation to assess system performance.

Indeed, MIT's system analyzes system performance, even time, there is a maximum signal input or the vehicle is displayed in an on-line display. For certain applications, the an automatic or guided mode which receives guidance signals almost continuously, that should provide sufficient opportunity to assess system performance. MIT believes. Actual system performance is compared with ideal response by means of statistical analysis.

Like Spartan, MIT has started with conventional, a conventional autopilot, then added the self-aligning feature to automatically adjust system gain. One advantage of this approach is that the basic stabilization and con-

RUGGED AND RELIABLE
New!
TRANSISTORIZED

A. W. HAYDON COMPANY'S
TRANSISTORIZED SUB-MINIATURE
ELECTRONIC TIME DELAY RELAYS!

SAVE SPACE AND WEIGHT!

	Miniature	Sub-Miniature
Size (height)	1 1/2" x 1 1/2"	1 1/2" x 1 1/2"
Length	2 1/2" long	1 1/2" x 1 1/2"
Weight	4 grams	1 gram
WIRE SIZE	1/16" to 1/32"	1/16" to 1/32"

RELIABOUS PERFORMANCE!
 High Reliability 100% TESTED
 Standard 1000 Cycles at 100 Hz
 Contact arrangements up to 4 pins double throw
 Switching capacity 100 mA max. contact current
 Time delay from 100 μs to 100 seconds. Analog delay available
 Remotely controlled switching

MEET
REQUIREMENTS
 OF MIL SPEC.

A W

A. W. HAYDON Company
 1000 CENTRE ST. WILMINGTON, MASSACHUSETTS
 U.S. & CAN. Divisions of International Spring Division



"AI RESEARCH MAXIMIZER"

GUARANTEED 20 M.P.H.
Speed Increase At Same Horsepower

Aileron Gap Strip (optional), not shown, improves single engine control and stall characteristics, and lowers stalling speed.

AirResearch
**MAXIMIZER
KIT:**

Scientifically
engineered bottles
with integrated
BPA-free
modifications

- Modern "Siamese" exhaust system
- Diffuser enclosure for oil cooler
- Roll wheel fairing
- Wheel well doors

THE GANNETT CORPORATION

AirResearch Aviation Service Division

Los Angeles International Airport, Los Angeles 43, California

MAIL COUPON

AirResearch Aviation Service Company • Los Angeles International Airport, Los Angeles 45, California

Please send me detailed information on the "ALRESEARCH MAXIMIZER" by:

4444

51000

214

START

progress report on *Acanthopneuste*

MEN AND IDEAS IN MOTION: AERONAUTRONIC

Aerospace is moving into the future and creating fast. Space advances, missile technology and space vehicles... computers, electronics... tactical weapon systems... these are major research

Exceptional engineers and scientists are needed now. If you are forward-looking and want to be an important part of a forward-moving organization, you'll find a new challenge and rewarding future at Aerostar—where men and ideas are making

For information regarding products, services, or other information, please contact us at 1-800-441-4444.

OFFICE OF ADVANCED RESEARCH • SPACE TECHNOLOGY DIVISION • COMPUTER DIVISION • TACTICAL WEAPON SYSTEMS DIVISION

AERONUTRONIC

an imprint of FORD MOTOR COMPANY

[illegible]

MORE OF THE GARLOCK 2,000



It's your move... BUT PLAY SAFE!

SELECT GARLOCK MOLDED AND EXTRUDED RUBBER PARTS FOR ASSURED QUALITY

You can be sure of consistent high quality when you specify Garlock molded and extruded rubber parts. Why? Because Garlock has broad experience in compounding natural and all synthetic rubbers including silicone. Whether your problem involves temperature extremes, difficult liquids or gases, compression set,

abrasion, or tear resistance—Garlock engineers can recommend a material and design best suited for the job. Moreover, Garlock manufacturing facilities are available for large quantity production of molded and extruded parts.

Molded and Extruded Rubber Products are another important part of "the Garlock 2,000" . . . two thousand different styles of Packings, Gaskets, and Seals for every need. The only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him today, or write us about your needs.

THE GARLOCK PACKING COMPANY, Pelham, N.Y.

For prompt service, contact one of our 36 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK



Packings, Gaskets, Oil Seals, Mechanical Seals,
Molded and Extruded Rubber, Plastic Products

ted loops of the autopilot are closed independently of the adaptive control loop so that failure of the latter will still leave the basic autopilot operative, but nonadapting.

Another advantage, cited by MIT's Dr. M. F. Whitham, is that separate standard models can be used for the inner (instrumented) and outer (command) loops, each with characteristics best suited for its particular function.

System That Learns

Whether and if it may be possible to design self-adapting systems, which not only adjust their performance to a particular established optimum, but which have the ability to learn by storing information as that are obtained and using them again when the same conditions come. (University of California at Los Angeles, working under sponsorship of the Force Office of Scientific Research, is investigating the learning model approach to self-adapting control systems, a spokesman reported.)

In the self-adapting autopilot which MIT tested on an F-4C, pitch axis performance was adapted automatically by means of three servo-driven potentiometers as follows:

- **Alpha** adaptation loop's open-loop sensitivity was automatically adjusted to make velocity constant of the control system equal to velocity constant of selected pitch-rate model.
- **Roll-rate** (dragging) loop's open-loop sensitivity was automatically adjusted to minimize the integral of the absolute value of the pitch rate error signal or of the rate of change of the error signal over the sampling period.
- **Pitch** optimization of control system response to match model response was achieved by automatically varying dynamic compensation parameters so as to null out the integral of sampled pitch rate over signal.

Compared with the Honeywell system, the MIT autopilot requires a somewhat longer time to sample system performance and to adjust its performance characteristics. Sampling time begins with initiation of input signal and terminates when rate of model output to input signal reaches desired value. Sampling interval can be varied in different selected models.

A less designed version of the MIT self-adapting autopilot, using integrating gains for attitude reference, is scheduled to be flight tested soon on an F-105A.

Self-adapting autopilot technique described by General Electric's M. F. Whitham resembles that of MIT in that it does not require rate input signals and relies upon measuring system performance during several command signal inputs or outside vehicle disturbances.

One basic difference, however, is that General Electric adapts only a single

parameter by optimum system performance, instead of three used by MIT, which speeds up the operation. The controlled variable is attitude angle rate.

General Electric's approach is to design an adaptive system which scales to maintain the natural frequency of the autopilot-reference combination at a desired value by controlling the open-loop gain of the inner loop.

To make the system frequency sensitive, General Electric employs a lag network and a lead network, whose time constants are the reciprocal of the desired zero-steady-state natural frequency. Airframe angular rate is measured by

a rate gyro, is fed into the two networks. If natural frequency is higher than desired, output signal from the lead network will cause servo-driven potentiometer (called a "multiplier") to increase system gain. If natural frequency is too low, output signal from lag network will operate multiplier to decrease system gain. Mrs. said.

General Electric's adaptive flight control system work, carried on with company funds, is expected to receive NASA Bureau of Aeronautics support in near future with view to testing techniques on a Navy jet fighter.

NASA's American Aerospace Data system which will build flight control

DELTA Air Freight costs less than you think!

Holds down inventories! Holds down costs of testing, insurance, capital tie-up. Protects against devaluation and market declines!

Delta's all-compass fast service covers including:
11-hour service,
50 ton capacity

Call Delta Air Lines
to learn
General Offices:
Atlanta, Boston,
Chicago, etc.

DELTA
AIR LINES
AIR FREIGHT
SINCE 1938

MOST COMPLETE AIR CARGO SERVICE TO AND FROM THE SOUTH

ENGINEERS

- Design • Research • Development
- Electrical Controls • Gearing • Bearings

Projects include constant speed drives, hydraulic motors, pumps and other components for commercial and military aircraft and missiles.

Send Resume and Technical Background Data to:
SUNDSTRAND Personnel, Dept. A, 1405-22nd Ave., Berkeley, CA
SUNDSTRAND AVIATION

A system with complete files, complete data and complete processing... to handle all operations.

It's a proven fact... that of the total work necessary to put a missile into the air, a staggering 90% is primarily logistical and involves the control of many individual maintenance parts. This figure becomes compounded as the number of missiles, but ready-to-fire missiles increases... and keeping track of their individual needs becomes a herculean task.

It is clear that an efficient system of organizing, filing and searching great masses of data at high speeds, and at relative costs is necessary. The Magnavox Company answers the need for "discrete" with data record handling for both government and industry with Magnavox.

You are invited to investigate our mobile use of these new techniques... write today for illustrated brochures.



Magnacard



DATA HANDLING EQUIPMENT BY

Magnavox

FOR MILITARY LOGISTICS AND INDUSTRY



THE MAGNAVOX CO. • DEPT. 61 • Government and Industrial Division • FORT WAYNE, IND.

SAFETY

C4B Accident Investigation Report

Engine Fire Contributes to Miami Crash

Bentall Services Flight 971, a Douglas DC-7C, crashed approximately 700 miles west northwest of the Miami, Fla., International Airport May 23, 1970, at 0805. The accident occurred at night under VFR conditions less than two minutes after takeoff from runway 27R. There were 24 persons aboard including 15 passengers and a flight crew of five. All five flight crew members and 16 persons, passengers, survived. Four Bentall Services crew were lost, ditching in Panama in kay, a complete wreckage to date. Two of the flight passengers died. The captain and first officer of Flight 971 were seriously injured, the second officer a flight crew was, received a broken leg and other injuries. The aircraft, with no engine, on May 24, 1970, was partially destroyed by subsequent impact and ground fire.

HISTORY OF THE FLIGHT

Bentall International Flight 971 was originally scheduled to depart New York, N.Y., for Miami, Fla., on May 23, 1970, at 2145 but due to fog, the flight was not made, owing to shortage of equipment and scheduling difficulties on the date. A 9701 was forced into Dallas from Miami, arriving at 0805 on May 24 for use as Flight 971. The aircraft was serviced and made ready for the trip to Panama City, Panama, the first scheduled stop on the route to San Juan, Puerto Rico.

The crew consisted of Capt. Thomas H. George, First Officer John C. Worthington, Second Officer Charles F. Link, and Cabin Stewardess and Stewardess Miriam Chapman.

The flight departed the Miami terminal at 1545 loaded to capacity 27R, where visual takeoff was accomplished. Shortly thereafter, and in accordance with tower clearance, a climbing right turn was initiated through the turn the No. 5 engine and fuselage and a fire developed at that area. The airplane, still in a right turn, started to lose altitude rapidly. While hovering in a north-northeast direction a crash in an open marsh containing scattered trees and underbrush.

Rescue operations were immediately initiated but were seriously hampered by low ground visibility of 1/4 mile or less, at the time. Several of the passengers and crew members were assisted by U. S. Coast Guard helicopter down to hospital grounds in Miami and the other crew, except for the cabin stewardess, and taken to hospital.

INVESTIGATION

Ground impact marks revealed that the aircraft struck the ground with upwind angle 24 deg. at night, while descending at an angle of approximately 10 degrees. The right wing hit contacted the ground

first and the aircraft broke up immediately thereafter when the midspan wing wing structure, the engine, and the fuselage struck the soft ground.

The wreckage was strewn along a half mile track on a heading of 215 deg. The fuselage structure broke into three major sections. After separating at station 160 the aft section, with the tail section and attached stabilizer and aileron about the entire length of the main ground path. This portion came to rest on its left side about 100 yards to the left of the ground path on an embankment. The cabin and forward fuselage sections separated and were found nearby. The cockpit and forward section of the fuselage, located at station 140, was found in an upright position approximately 1300 ft. from the point of initial impact, on a heading of 205 deg. The damage to the top of the forward fuselage section was relatively light.

The lower front end part of the section was pushed down and distorted during the slide. The middle portion of the lower part of the section remained attached to the wing center section was found at approximately 1500 ft. from the point of initial contact. This section which was located during a portion of the ground slide, came to rest right side up. During the time it was inverted the entire upper portion of the fuselage, down to the wing frame was destroyed. The left-hand wing center section was recovered by an aerial hoist.

The main wing and the right main wing were seen separated from the aircraft during the ground landing. The main wing assembly was found in a scattered position 1510 ft. from the point of initial impact. The right main wing, after it had slid along the ground path, the left main

wing remained attached to the wing center section and was subjected to severe fire. It was determined that all four main wings in this position pointed at impact.

The present flight control section, although damaged by the ground impact, was sufficiently intact to indicate that no control failure had occurred in flight. All components of the elevator and rudder systems were available for observation from the above section, and complete forward view as forward as the stabilizer section, which was located in the middle of the wing structure by the center ground path, as the left wing center section. All features of the individual systems components which were located and identified were examined and all appeared to have been the result of overloading during the structural loading of the engine.

General Examination

In this report, the internal control system was not damaged by the impact fire. This, which was the path of the control system, was damaged or lost, nevertheless sufficient parts remained which such as a condition that permitted an examination and a conclusion that the control system was functioning properly.

The right wing center section, including No. 1 and No. 4 nacelles was examined to fully establish its condition, subject for patterns and the extent of the damage to the structure. The right wing damage was confined to the No. 5 nacelle and the upper and lower wing box frame, immediately forward and aft of the nacelle. The entire fuselage frame is situated to maintain and clearing of the main fuselage section, a wing section from the fuselage.

Due to the pattern the indicated the



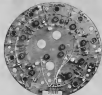
TAKING off to the south, Bentall DC-7C crashed and bentall 51 on from Miami Airport. The aircraft broke up after making turn to the right following initial engine fire.

U. S. Coast Guard helicopter down to hospital grounds in Miami and the other crew, except for the cabin stewardess, and taken to hospital.

AVIATION WEEK, February 9, 1971



QUALITY ASSURANCE



TI TRANSISTORS IN EXPLORER IV

Explorer IV was developed on an extremely tight schedule and was built to withstand one operation for the space shuttle retrieval from Texas Instruments which enabled us to meet the project deadline for successful launch.

James D. Van Allen
Chief, Department of Physics
University of Texas



WORLD'S LARGEST SEMICONDUCTOR PLANT

Added reliability and economy are the dividends to users of Texas Instruments transistors made possible by SMART—simplest test of the Semiconductor Components Division Quality Assurance program. This Sequential Mechanism for Automatic Recording and Testing evaluates transistors automatically and economically with consistent accuracy.

Only advanced facilities can produce advanced components. SMART, designed and built at TI, tests 18 transistor parameters and punches the results onto an IBM card code to the corresponding transistor. Test results are then available for individual or collective statistical analysis.

With SMART, one operator can test a far greater number of transistors than before... automatically. Effective TI Quality Assurance, advanced by SMART, is another reason why engineers the world over rely on advanced components from the nation's leading manufacturer of semiconductor devices and precision components.



**TEXAS INSTRUMENTS
INCORPORATED**
SEMICONDUCTOR COMPONENTS DIVISION
P.O. BOX 5000 DALLAS, TEXAS 75220

for Flight 971. The previously lost speed of the flight log which indicated no manual intervention. The company status report also stated that during the period that N 1904 was on the ground at Miami, he personally checked the aircraft log and found no errors thereon. The first flight log was "destroyed" on Flight 971 of May 25 and was fairly apart.

The aircraft was manufactured on May 24, 1957 and had accumulated a total time of 1,367.46 hr. at the time of the accident. The last three maintenance checks and the last stress check were received and found to be completed and signed off by the engineers and inspectors. The inspection work sheets indicated nothing significant pertaining to the engine, airframe, or electrical system. The last No. 1 check was accomplished at Dallas on May 23, 1958, at which time the aircraft had accumulated a total time of 1,292.94 hr. The last service check was performed at Miami on May 24, 1958, at which time the aircraft had accumulated a total time of 1,295.91 hr.

Reports Reviewed

A review of various reports revealed that they contained either minor and superficial items. One item concerning a cracked main engine frame in the right fuselage filler had been covered through the last three maintenance checks since Feb. 15, 1958, and was still outstanding at the time of the accident.

The aircraft flight log and flight inspection log were Jan. 1, 1955, not received and they indicated that the engine had been operated according to the instructions recommended by the manufacturer. Although comments with respect to pilot, certain maintenance items contained in the flight log had been "deleted" for correction at Dallas, it was determined that none of these items was of such a nature as to affect adversely the aircraft's use at the accident.

The flight log scheduled for Flight 971

was in the operations office about 1250, May 24, and began their routine duties prior to flight. Capt. George examined the aircraft report over the radio thoroughly, signed the various ground documents and signed his clearance. First Officer Woodhouse prepared the flight plan and upon completion handed it to the station agent for further handling. George sought of the aircraft was scheduled to be 114,550 lb. at takeoff (gross weight 141,260 maximum allowable). Second Officer Paul arrived in operations before the others and went immediately to the cockpit to conduct the preflight inspection. The engines were started and two clearance was received.

Normal Takeoff

Flight 971 roared from the Miami International terminal ramp at 2310. Air Route Traffic Control (ARTC) clearance was delivered on ground frequency at 1602. May 25, 1958. The flight climbed to lower frequencies and was cleared into the active pattern. 2700 to make a right turn after takeoff, climbing on its scheduled heading 090 deg. used heading 2,000 ft. before proceeding on course. The flight departed without incident at 1604.

Texas personnel stated that the aircraft made a climbing right turn shortly after takeoff. When it had reached an altitude of approximately 800 ft., a light orange glow was observed on the right side of the aircraft. The aircraft was further cleared to enter a descent, contacting the ground at 1606. Immediately prior to impact, Texas personnel heard a CPT. Flight 971: No other messages were received from the flight following impact.

Following the accident, First Officer Woodhouse and Second Officer Paul were interviewed regarding the circumstances leading to the accident. Both stated that perfect attention was given and that no discrepancies were noted during the postflight engine check. The last officer stated that Capt. George made the takeoff



Victoria Turboprop Designed for Rough Fields

New turboprop transport, designed by Eagle Globe & Aircraft Inc., Dallas, Texas, is being offered to delivery for use in short and medium haul Latin American and African operations. Admittedly a pioneer without two years, Aerojet is doing specifically for rough field operations. It will be manufactured in Latin America, but will receive U.S. Federal Aviation certification program. Designated Model 141 Victoria, the aircraft will be powered by four Lycoming V35 turboprop engines and will carry 60 passengers. Plans call for speed of about 170 mph, cruise altitude at 25,000 ft. and range of 1,800 statute mi., plus a 250 mi. reserve, with 18,000 lb. payload. Transport, which is based on the Martin 404 turboprop, will cost between \$500,000 and \$600,000.

AVIATION WEEK, February 9, 1959

are
you
using
only
HALF
your
potential

In your present job?

Because of the diversity and rapidly increasing demands for our products, you have the challenge of opportunity here at Bendix Pacific to continue to grow with us.

There are immediate career positions open NOW at all levels in our small, independent engineering groups in these fields—

**MUSCLE GUIDANCE — TRANSMITTERS
AERONAUTICAL RADAR — MISSILE HYDRAULICS & MARINE HYDRAULICS
SONAR & ANTI-SUBMARINE WARFARE**

Please write W. C. Willett who will acknowledge in full in the company mail room in today.

☐ I am a Bendix employee but not in the Bendix Pacific, Seattle, location.
☐ I am a Bendix employee but not in the Bendix Pacific, Seattle, location.
☐ I am a Bendix employee but not in the Bendix Pacific, Seattle, location.
☐ I am a Bendix employee but not in the Bendix Pacific, Seattle, location.

I am not a Bendix employee but would like to know more about your company.
Name _____
Address _____
City _____
State _____



seven shades of gray

with the Hughes TONOTRON® Storage Tube

Able to present as many as seven shades of gray, the TONOTRON® cathode-ray storage tube now provides you with high-fidelity picture reproduction.

In addition, the Hughes TONOTRON® tube features high picture brightness (in excess of 1000 foot lamberts with full back-lamp output) and controllable persistence.

Other Hughes electron tubes include the semitransparent storage tube, and a family of storage-ray tubes with a wide variety of variable tubes designed to meet your storage requirements. Hughes continues to maintain leadership in the field of storage and measurement tubes.

Collins Airborne Weather Radar System WP-101 incorporates the Hughes Type 2033 Gasplane Deflection Transmitter® tube. This system provides the pilot with a continuous high-fidelity picture of weather conditions within a radius of 150 miles. Ground mapping—a secondary function—shows the location of cities, lakes, rivers, mountains, and shorelines, and dangerous obstacles. Even at direct sunlight, no warning is lost or repeated.

For additional information regarding any of the Hughes electron tubes please write: Hughes Products, Marketing Dept.—ELECTRON TUBES, International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

5000 MARKET AVENUE, SANTA ANA, CALIF.



Typical tube face in a commercial unit.

PHOTOGRAPH BY AP/WIDE

was able to reach the cockpit controls. At this time the captain stated there was no fuel, and he was then asked to shut the engine down. He stated that the engine was still running, but he was then asked to shut the engine down. He stated that the engine was still running, but he was then asked to shut the engine down. He stated that the engine was still running, but he was then asked to shut the engine down.

School of the Air, and he was then asked to shut the engine down. He stated that the engine was still running, but he was then asked to shut the engine down. He stated that the engine was still running, but he was then asked to shut the engine down. He stated that the engine was still running, but he was then asked to shut the engine down.

Mr. Tish further said that after No. 3 was launched they did not receive power on the remaining engines. When asked about the attitude of the aircraft following the launch, he said he thought it was being pulled straight and that no great maneuvering was going to the aircraft. However, he stated that he did not have his headset on and did not hear any communications with the tower when the flight was in flight. He stated that he was in the cockpit right from the time he followed the launch.

Passenger Reaction

In the cockpit of the investigation, the main area observed from a number of passengers who were "Shed" (Pilot 971). There was no great reaction on the part of the other crew members, but there was a lack of light and the engine from the area of the launch engine on the right side of the aircraft. They said the flight was very smooth, and they were very comfortable. They said the flight was very smooth, and they were very comfortable. They said the flight was very smooth, and they were very comfortable.

Those who were seated in the forward cabin directly behind the flight deck stated that they noticed the aircraft was in a state of flight, and they were very comfortable. They said the flight was very smooth, and they were very comfortable. They said the flight was very smooth, and they were very comfortable.

When the aircraft came to rest, the first leg was in a state of flight, and the aircraft was in a state of flight. They stated that they were very comfortable, and they were very comfortable. They stated that they were very comfortable, and they were very comfortable.

advanced engineering opportunities with the TAPCO GROUP of Thompson Ramo Wooldridge Inc.



REWARDING RESEARCH OPPORTUNITIES for engineering specialists now exist in the Advanced Engineering Department of the TAPCO GROUP at Thompson Ramo Wooldridge Inc. This is a continuing and expanding program. The TAPCO GROUP, made up of five major Thompson divisions, is serving the Aero-Space, Electronics, Nuclear and General Industrial fields with fully integrated facilities for research, development and production of structures, propulsion systems, electro-gasdynamic-mechanical auxiliary and accessory power systems, electronic controls and check out equipment, and fuel systems involving solid-state, liquid and nuclear fuel studies.

If you would like to join the personnel of the Advanced Engineering Department in studying work at the frontiers of knowledge in these areas, there are opportunities for men with the following experience:

GRS DYNAMICS—Internal and external flow, single and two phase flows, transonic and supersonic flows.

HYDRODYNAMICS—Experience in boundary layer calculation and model.

APPLIED MECHANICS SPECIALIST—Experience in hydroelastic, system analysis, system synthesis and vibration techniques.

PROPULSION SPECIALIST—Familiar with gas dynamics and thermodynamics of nozzle flows and combustion of solid and liquid propellants.

INTERACTION THEORY ANALYST—Experienced in mathematical analysis of mechanical and electromagnetic transmission of interaction.

PARTICULAR PHYSICIST—Familiar with the physics of gases and liquids, mechanical and electromagnetic wave propagation within their media.

SOLID STATE PHYSICIST—To work on detector elements.

MAGNETO HYDRODYNAMICIST—To work on advanced propulsion systems.

APPLIED MATHEMATICIAN—Experience in logical programming of systems and statistical or computer and probability theory.

Your experience means should contain personal, educational, experience data, and salary requirements. Send to: DIRECTOR OF PLACEMENT, All replies will be held in strict confidence.

TAPCO GROUP

Thompson Ramo Wooldridge Inc.

3300 BURLING AVENUE • CLEVELAND 17, OHIO
Phone 1 (Area 1) 7500, Ext. 4000, 4001
Founded in 1907 Phone in 20 Cities

Nuclear Research and Development Center

QUIET QUIET QUIET QUIET QUIET



New super-soundproofing, new double-stack windows and windshield (quarter rock) keep the noise out of the Apache's cabin — really keep it out! And new sound-dampening jet engines take the "back" out of the exhaust. You never "hear" each pilot in a business airplane.

See and fly the new 1999 twin-engine Piper Apache. You'll see and hear an amazing difference. Many other things you'll fly, too, such as the completely new instrument panel with seven located radars. More than ever the Apache is your very best twin-engine buy. \$56,995, with 160 horsepower Lycomings standard! And the new Autofine Apache comes equipped with built-in automatic flight system. See your dealer or write for new 1999 Apache catalog, Dept. K-1, Piper Aircraft Corporation, Lock Haven, Pa.

PIPER

Apache

ATTRACTIVE LEASE AND FINANCE PLANS AVAILABLE

still rules and the heavy cockpit had remained 4 in. A special observation was taken at 0072, on minutes following the crash. The observation indicated a momentary rolling of 7,500 ft. (vertical) with stability in a forward leg and the major south side.

The first turbine engine thrust (left) for variable pitch, clockwise about 3,000 for 100° while the wind shift factor for Vmax called for southeast winds below 5,000 ft.

The forward fuselage for Vmax (about 1700) called for a broken rolling about 10,000 ft and no rotation in its side between 1400 and 1600 on the 27th. The forward fuselage which came out about 2100 on the 24th indicated side down and 3 in on ground leg from 2100 to 2700 at Miami with conditions accordingly, however, in that observation and 1 in on ground leg. At 2112 on the 24th however, no movement in the Vmax forward fuselage until the climb and 1 in on ground leg between 2400 and 2512.

During the course of the investigation a test flight was conducted under the supervision of a flight instructor to determine whether any unusual flight side or maneuver would be required to place the aircraft in line with the aerodynamic path. Using the previously stated operating procedures, a DC-6C was flown at power 27R, in a ground state, the aircraft was in a heading approximately that of the ground track. This was done as completed with a climb, but not exceeding 28 deg. The test aircraft which is approximately 5,800 lb lighter than N 100A, reached an altitude of 1,000 ft over this point in less than two minutes from that of takeoff roll.

Crew Training

All Bessell crew training is conducted at the company headquarters in Dallas Texas. A study of the above conditions for DC-6C indicates that training is done close and comprehensive. The ground school course, which is given to both captain and first officer, consists of 35 hr of study of aircraft systems, aircraft performance and operations, and emergency procedures. Each pilot is provided with a manual of four items which he is required to study. Also, each pilot is assigned to stay on maintenance on the aircraft. One pilot remains on duty while the other Captain George and First Officer Whittaker successfully completed the course.

According to Bessell's chief pilot, the company has no flight instructor training and none is required. He stated that in addition to both training, cockpit procedures training is done in the aircraft at 100 ft, rather than the ground in the air. All low engine flight training is accomplished at Dallas. The entire crew must receive some refresher training. A captain is required to fly DC-6C equipped for a period of six months prior to becoming eligible to qualify as captain on DC-6/DC-7C type equipment. The captain is not allowed to fly a DC-6C without the captain's log.

Qualification on DC-6/DC-7C requires a minimum of 75 hr on engine training. No more than 100 hr is scheduled as captain. However, he may be scheduled

as alternate for any portion of the 75 hr at the discretion of the chief pilot. Each captain receives a minimum of eight hours local flight instruction, followed by a post-flight flight check and equipment type rating conducted by a qualified check pilot. Each George qualified in the course during May, 1957, and successfully passed his DC-7 line check on May 25, 1957. The last instrument check was accomplished Jan 11, 1958, in DC-6 equipment.

Qualification for DC-6/DC-7C First Officer Flight Transition Course entails a review a minimum of three hours airplane and cockpit fundamentals, followed by 45 hr of on engine training on scheduled on scheduled post-flight flights and three more 24 hr of local flight instruction. The 14 hr of on engine transition was completed, usually to 20 hr at the discretion of the chief pilot. In cases where the on engine transition time has been reduced to 18 hr, the local flight instruction time shall be increased by 1 hr. First Officer Whittaker completed and qualified in the transition course.

The standard check procedure for on engine flight (high segment) is equally comprehensive. Each second officer is provided with a manual containing all pilot and information necessary for his training. During the 310 hr course of instruction the subject matter covered consist of flight segment status, theory of flight and aircraft systems, maintenance of aircraft and engine, aircraft and engine performance, comparison, aircraft systems, trouble shooting and emergency procedures. Each second officer is required to pass a cross

section covering all these subjects. In addition, the DC-7C flight segment course is given an additional 45 hr of instruction prior to test check-out. Captain George's additional Second Officer Flight rating was completed. These courses prior to assignment in this type of assignment.

Capt. George has been a captain for Bessell for over 18 years. His total flying time is over 20,000 hr. According to company records 241 of this has been in DC-7 aircraft and 177.5 hr in any segment in the 30 days prior to the accident. The remaining 115 hr was accumulated during the previous seven months. Capt. George had approximately 200 hr of scheduled operations in DC-7 equipped. He has also accumulated several thousand hours in other four-engine type aircraft.

A review of company pilot check records of Capt. George for a period of about 10 years showed that he had been given some, that the minimum required number of flight checks. In several instances it was necessary for him to be rechecked in company check pilots because of his control failure to receive proper grades. Some instrument flight checks indicated inability to maintain altitude during turns; however, he did pass checks and received an "A" grade.

ANALYSIS

During the investigation of the 201 hour the possibility was advanced that the captain intended to make an immediate off-sight landing because of change in the altitude by the first.

The Board is aware that for a flight

Eliminates antenna shading

Autonetics' new *Autonetics Antenna Selector* insures uninterrupted radio reception in military and commercial aircraft. Used with dual-antenna systems, it assures a strong, continuous signal. Does away with manual switching and losses due to coaxial toes in the antenna feedlines. Simple to install... has a 10,000-hour operating life with minimum maintenance... completely reliable during high-speed maneuvers and in environmental extremes. Meets stringent military requirements.

Autonetics

Autonetics is a subsidiary of the Autonetics Division of General Motors.



26th ANNUAL INVENTORY OF AIRPOWER ISSUE

PUBLISHING DATE: MARCH 8, 1959

In twelve swift-paced months, aviation's galloping technology has made dramatic breakthroughs in all areas of flight. Commercial jet transportation became a reality. Corporate fleets can now pick from a number of superb jet or prop jet aircraft. Air ICBM has been successfully over its full range of capability. Aircraft flying at twice the speed of sound are now operational with the USAF. Larger and more sophisticated satellites were launched around the globe. Actual strategic warheads to attack the moon. Space Technology has excited the imagination of the entire industry.

Event followed event as with such rapidity that interpreting their significance has been difficult for even the most well-informed engineers and managers. Once again, they need a concise, penetrating analysis and forecast of world happenings.

ONLY ONE SOURCE FOR THE ANSWERS

Industry's decision makers, turn to the industry's top reporting team—AVIATION WEEK'S 33-man editorial staff of graduate engineers and aerospace specialists. The nine whose full-time job is to ferret out and report world aerospace events. In the Inventory Issue, they will bring you focus the significance of hundreds of technological and marketing developments witnessed in 1958 and interpret their impact on future technological growth.

CONTENTS OF THE INVENTORY ISSUE:

Charts, graphs, tables, specifications will cover in detail, budgets, manning, maintenance, engineering, statistics and many more areas of military and civil aviation. The Inventory Issue has been relied on for 25 years as the only complete authoritative source for detailed specifications on U.S. and foreign aircraft, missiles, helicopters and new space vehicles.

YOU BELONG IN THE INVENTORY ISSUE

Over 70,000 key engineering-management executives, decision makers in the industry, are eagerly awaiting this important issue. They will read...study...and refer to the Inventory Issue throughout the year. Here is a rare opportunity to place your sales message in a climate of proven editorial impact. Because of its long use by you, you get in a house...MULTIPLE EXPOSURE...of your sales message. In addition, a reader service card is included to facilitate the handling of thousands of inquiries generated by this important issue.

For additional information on this once-a-year opportunity, write, wire or letter jet phone your AVIATION WEEK district office. Regular space rates apply.

A MCGRAW-HILL PUBLICATION, 330 WEST 42nd ST., NEW YORK 36, N. Y.

Aviation Week

Introducing Space Technology



ABC JUNE 1959-65,726



Stressing the importance of reliability!

Through the ultimate in design data provided by our Reliability Group, Rohr Engineers are able to design the greatest efficiency, dependability, and economy into Rohr-built aircraft components.

Working with every modern test device (such as the fatigue testing machine shown above) Rohr reliability men chart thousands of stress spectrums and other data to predict the safe life of given materials at given stress loads.

Reliability is another reason Rohr is widely known as the **WORLD'S LARGEST PRODUCER OF COMPONENTS FOR FLIGHT**



MAIN PLANT AND HEADQUARTERS: CHULA VISTA, CALIF.; PLANT IN RYDSTEDT, CALIF.; ASSEMBLY PLANTS: WINDSOR, ON; ALBUQUERQUE, N.M.

accuracy, but the detection of such items was having been taken as a bonus. In any case, often such accuracy would have been more of the control deficiency.

Validity in the report was also reported in right order by the team. Since the score of the accident was approximately three miles from the target, patches of ground fog at the accident site would not have actually interfered with the score at the target.

A N 3004 missed on a free flight from Dallas, Tex. May 16, a Vaux horn rate-torque observed under testing from the No. 1 engine. The three although indicated by the three first number was observed trailing from the No. 1 engine, did not catch the information on the light fog. It is possible that had the horn done an inspection could most likely have detected the defect, cylinder. It is difficult to understand who the was not entered in it would have required an inspection at Miami. Because of the full system in the case of the first flight, the Board is unable to determine the reason for the accident not being sent on up to the aircraft log.

Cylinder Scuffing

The problem of cylinder wall scuffing in the turbo-compound engine has been in doubt since the Civil Aeronautics Board and the Civil Aeronautics Administration are studying the problem related to that model engine. The Civil Aeronautics Administration on June 10, 1955 issued an order (Directive 10-115, Part 1) of this Directive calls for the mandatory replacement of the second chamber piston compression ring with a carbon ring at first even build after Aug. 1, 1955, but no later than May 1, 1957.

Even so the accident, Borell, Aeronautics was in the process of replacing the chamber piston rings with an oil ring in engine at the accident incident. The No. 1 engine involved in the flight did not have the oil ring prime ring installed in the engine, but not needed in accident ground. Since the accident all Borell engines have been sent back to replace the second chamber piston compression ring with the carbon ring in accordance with the Aeronautics Directive of June 10, 1955.

New procedures in the cylinder oil ring are being pursued as the fact of combustion ring or being unsuitable to support oil ring based lubrication, as recommended by the manufacturer's service bulletin dated Dec. 10, 1957.

In addition to compliance with the Aeronautics Directive of June 10, Borell is also developing oil cylinders which indicate even better chamber lubrication is shown by the system analysis. Also, all cylinders are being inspected during line maintenance or operations in the engine under 480 in operating time. Since the installation of these pistons following the accident the engine has not experienced a single instance of cylinder hard failure.

As a part of the accident investigation, the Board has covered almost the quality, design requirements and standards of the engine and its ground and flight testing conditions and facilities. We are unable to find any more defects, which we would consider open today to the accident. The preoccupation of the engine under the conditions of operation with which we



To obtain full data for a full aircraft engineering career

write at once enclosing resume to Mr. J. L. Hebel, Industrial Relations Manager, Rohr Aircraft Corporation, Chula Vista, California.

The availability of ultimate design data

is just part of many reasons for growing Rohr offers more satisfaction, security and professional growth to the skilled aircraft engineer.



CHULA VISTA AND RYDSTEDT, CALIFORNIA

Structural engineers

The Columbus Division of North American Aviation has new positions open on our Engineering Staff:

STRUCTURAL & D ENGINEER: To assume responsibility for improving and optimizing structural analysis methods and techniques. Current studies include development of fatigue criteria, nuclear effects on structures, thermal cycling, and associated high temperature studies, including creep effects, thermal stress, structural cooling, and insulation. This man will support advanced design efforts.

STRUCTURAL LOADS ENGINEER: Capable of deriving structural design loads resultant from flight and ground dynamic-loading conditions. Complete analog and digital labs available for your programs. Projects include Methods Development and Advanced Design support.

Increased R&D activity coupled with expanding work loads has created these permanent positions to become available. If you have a degree or degree and professional experience in these fields, please send your resume to:

IE KEEVER
Engineering Personnel Manager, Box AW702
North American Aviation, Inc.
430 East Fifth Avenue
Columbus 16, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.



Makers of the T-12 Jet Trainer and the A-1J Vigilante

WHO'S WHERE

(Continued from page 23)

Changes

Pdly L. Mohel, chief of advanced research, Senior Aircraft Division of United Aircraft Corp., Stratford, Conn. Also Edward S. Collins, Jr., assistant to the chief engineer, Capt. Herbert S. Brown, Jr. (USN, ret.) supervisor of project and flight operations.

McDonnell Aircraft Corp., St. Louis, Mo. has announced the following engineering and manufacturing appointments to the development of the space capsule for Project Mercury: **Logan T. McMillan,** corporate vice president; **Edwin M. Fleck,** engineering manager; **John F. York,** project engineer; **B. E. Peters** and **G. F. Wales,** assistant project engineers; **William Dabbs,** manufacturing manager; **Earl Whitlock,** space project planner.

Richard Mauer, manager of sales marketing, Carlton Industries, Inc., Milwaukee, W. Va.

Dr. Robert D. Tauschke, assistant head of systems analysis department, Hughes Aircraft Co. a General Systems Group, Torrance, Calif.

Mr. James S. Street, special assistant to the president, General Dynamics Division of General Dynamics Corp., San Diego, Calif.

Karlbert C. Kallen, manager of design engineering and test research, L. Korman, manager of engineering research, United Aircraft Division, American Airlines, Inc., Memphis, Tenn.

Gene Hopkins, director of marketing, Denver Scientific Co., Concord, Calif.

Dr. Herbert G. Saggel has joined Boeing Aerospace Co. as director of the Division of Systems, Seattle, Wash., to direct the systems analysis group associated with the development of the Space Shuttle launch vehicle.

Robert O. Fagg, director of labor relations, Russell Service, Inc.

Patrick Dwyer, American Corp. has announced the following appointments: **Earl Lee,** chief commercial manager; **John H. Stankovic,** chief of sales; **Mr. Lee** is general manager, Western Division, Eastman-Kodak Co., New Haven, Conn.; **Stankovic** is general manager, Eastern Division.

Two Douglas & Equipment Co., Bellmead, Tenn. has announced the following appointments: **E. E. Charles,** general sales manager; **Robert Cox,** domestic sales manager; **Tom Lee,** export sales manager; **Charles Morgan,** director of sales training; **Alan Jack Ricketts,** manager of public relations.

Robert B. Glazewski has been appointed to the Quality Control Division, Aerojet General Corp., Azusa, Calif.

Jack T. Caine, director of sales, has moved Pacific Division of Davidson, Inc., Los Angeles, Calif.

Charles O. Roberts, assistant to the president, Langley Corp., San Diego, Calif.

Charles E. DeBakey, manager of systems engineering, planning, Patco Corp.'s Civil Engineering and Industrial Division, Philadelphia, Pa.

Mr. DeBakey continues to maintain his office in Philadelphia.

Robert R. Schaeffer, research assistant director, Aeromedical and Instrument Division, Kaiser-Johnson Controls Co., Ann Arbor, Mich.



Mr. Don Lavers, Lockheed Aircraft Corp. vice president.

A message of importance to career-minded engineers:

"Lockheed aircraft continue to blaze new trails for manned flight. The new Electra is America's first prop-jet airliner. A Mercury version of the Electra will be the country's first turbo-jet powered subsonic fighter."

"Already, our design groups plan five supersonic jet transports of 1950 horsepower, new speed and altitude records set by a Lockheed F-104 Starfighter have opened flight to the fringes of outer space."

"Within and beyond the many problems for our engineers: problems in aero and thermodynamic characteristics of supersonic speeds, in radar, in optics, in infrared, in data processing for automatic direction systems and in all phases of design. Additional long range problems exist in military systems, missiles, nuclear and space civil systems, commercial air transport studies, and potential opportunities research."

"There are openings now for thoroughly qualified electronics and aero thermodynamics and design engineers and operations research specialists."

"If you are interested in a Lockheed career in California, write us today. Address: E. W. Don Lavers, Manager, Personnel Staff, Dept. 101, 1701 Empire Avenue, Burbank."

ENGINEERS: Write Mr. Don Lavers for your copy of a paper on "Aerospace Early Warning in the Missile Age" presented by Robert A. Bailey, Chief Engineer, California Division, Lockheed Aircraft Corporation, at the 5th USAF World Wide Weapons Meet.

Lockheed



QUARTERBACKING THE EAGLE PROJECT

Bendix Aviation Corporation will be prime contractor for the Eagle missile-and Bendix Systems Division will quarterback the project.

Latter in a series of important defense projects to be assigned Bendix Systems, the Eagle will be a long-range, air-tissue missile designed for fleet air defense and interception missions.

Responsible for systems management and engineering in connection with the project, Bendix Systems Division will also direct the development of the Eagle missile, electronic guidance, and fire control equipment in the launching strand.

Engineers and scientists with missile experience may find that their talents are suited to the special-

ized work involved in the Eagle project and other important system programs at Bendix Systems Division.

Located adjacent to the Engineering campus of the University of Michigan, Bendix Systems Division offers the best place for an outstanding opportunity to join an organization with full facilities for encouraging the finest work. Ann Arbor is a wonderful place to live and raise a family, a town which conforms to a college community with the nearby advantages of a large city.

If you are interested and are qualified in vacuum system planning, research and development, you are invited to write to Bendix Systems Division, Dept. A2-9, Ann Arbor, Michigan.



Bendix Systems Division
ANN ARBOR, MICHIGAN



...and the fun like the flying saucer. Discover Science at Radiation for you enjoy that part the year around.

We have many openings for the challenging and rewarding work in design and development. Reflective is well known in DATA RESEARCH, RESEARCH CENTER, and other areas of RADIATION TECHNOLOGY. Our growth pattern indicates a career line with personal growth for everyone with drive and energy.

Write today for complete details on opportunities available. If you qualify you'll see our list and work where to be in advanced and work a challenge.

Radiation Personnel Dept. 34
FABRICATION, Inc.
RADIATION AND ELECTRONICS

UNIVERSITY OF MICHIGAN is due to Graduate Fall 1961 in the following fields: *see below for details*
NEW: *see below for details*
PHYSICS: *see below for details*
CHEMISTRY: *see below for details*

MEANS OPPORTUNITY OFFERED
Technical Development Dept. Midwest Manufacturing Co. (MIDWEST) is seeking experienced and capable individuals for positions in the following areas: *see below for details*
1. *see below for details*
2. *see below for details*
3. *see below for details*
4. *see below for details*
5. *see below for details*
6. *see below for details*
7. *see below for details*
8. *see below for details*
9. *see below for details*
10. *see below for details*

POSITIONS WANTED
Developmental Plant (technical) seeking two persons (MICHIGAN) for the following positions: *see below for details*
1. *see below for details*
2. *see below for details*
3. *see below for details*
4. *see below for details*
5. *see below for details*
6. *see below for details*
7. *see below for details*
8. *see below for details*
9. *see below for details*
10. *see below for details*

Openings in the Midwest
Technical Development Dept. Midwest Manufacturing Co. (MIDWEST) is seeking experienced and capable individuals for positions in the following areas: *see below for details*
1. *see below for details*
2. *see below for details*
3. *see below for details*
4. *see below for details*
5. *see below for details*
6. *see below for details*
7. *see below for details*
8. *see below for details*
9. *see below for details*
10. *see below for details*

When Answering BOX NUMBER
to specify the heading of your response, we will send you more information. Please do not include a check mark in the box. We will include a check mark in the box to indicate your interest for each advertisement.

ENGINEERS AND SCIENTISTS

Have you opportunity to grow with a profit, expanding subsidiary of the Ford Motor Company. Considerable career opportunities are open in Aeronautics, some RESEARCH CENTER specializing in the Pacific, in Southwest Branch and the facility in Glendale, California. You will have all the advantages of a stimulating environment, excellent working with advanced equipment in a new facility located where you can enjoy California living at its best.

FOR THE RESEARCH OPPORTUNITIES with 15 years experience in field research, field maintenance, thermodynamics, aerodynamics and electronics, and electronics. To work in development and industrial systems related to energy technology and advanced rocket propulsion, research opportunities exist in many areas including: high temperature combustion, engine, turbine, fuel, heat transfer, and chemical reaction. Research areas include: *see below for details*

RESEARCH OPPORTUNITIES with a career opportunity in field and field research in the field of electronics, and electronics. To work in development and industrial systems related to energy technology and advanced rocket propulsion, research opportunities exist in many areas including: high temperature combustion, engine, turbine, fuel, heat transfer, and chemical reaction. Research areas include: *see below for details*

RESEARCH OPPORTUNITIES with a career opportunity in field and field research in the field of electronics, and electronics. To work in development and industrial systems related to energy technology and advanced rocket propulsion, research opportunities exist in many areas including: high temperature combustion, engine, turbine, fuel, heat transfer, and chemical reaction. Research areas include: *see below for details*

RESEARCH OPPORTUNITIES with a career opportunity in field and field research in the field of electronics, and electronics. To work in development and industrial systems related to energy technology and advanced rocket propulsion, research opportunities exist in many areas including: high temperature combustion, engine, turbine, fuel, heat transfer, and chemical reaction. Research areas include: *see below for details*

RESEARCH OPPORTUNITIES with a career opportunity in field and field research in the field of electronics, and electronics. To work in development and industrial systems related to energy technology and advanced rocket propulsion, research opportunities exist in many areas including: high temperature combustion, engine, turbine, fuel, heat transfer, and chemical reaction. Research areas include: *see below for details*

RESEARCH OPPORTUNITIES with a career opportunity in field and field research in the field of electronics, and electronics. To work in development and industrial systems related to energy technology and advanced rocket propulsion, research opportunities exist in many areas including: high temperature combustion, engine, turbine, fuel, heat transfer, and chemical reaction. Research areas include: *see below for details*

AERONAUTIC
A subsidiary of Ford Motor Company
1000 N. W. 10th St., Ft. Lauderdale, Fla.
Orlando, Fla.
Miami Beach, Fla.
Miami, Fla.

This is one of a series of informative messages to recruit engineers and scientists with the projects of RCA Moorestown.

RCA MOORESTOWN AND ATLAS

Responsibility for the development, design and production of an advanced launch control system for the Atlas missile is one of the challenges of RCA Moorestown. The system is designed to perform two primary functions: To determine the operational readiness of the missile and to control the actual launching of the ICBM into space.

The Atlas launch control system complex requires over 200 cabinets of relay logic and newly developed transistorized digital and analog computer circuitry. Of critical significance is the development of the complex use of the problems of reliability and accuracy, necessitating the use of advanced transmission techniques. The challenge of the project is increased by the need for obtaining and integrating information from many separate contractors and by the problems of concurrent research, development and production. The breadth and complexity of the Atlas launch control system are creating stimulating assignments in systems, projects and development engineering.

Engineers, scientists and managers interested in contributing to this program—or to other exciting projects—are invited to address inquiries to Mr. W. J. Henry, Box V-41.



RADIO CORPORATION OF AMERICA
MOORESTOWN PLANT, ENGINEERING
MOORESTOWN, N. J.

LETTERS

Critical Point

Since 1950 we have made tremendous steps in the direction of placement of our troops with an operational capability to meet an opponent on our terms—only the doctrine is backward. When Soviet-style tanks and anti-North Korean air and anti-aircraft missiles meet, and pilots in old F-105 and Comets are sent to battle the MIG we should have learned a lesson to support the argument that dual development of weapons systems is essential in the race of the two does not meet its combat needs.

[illegible]Michael Parsons
Canada, Cold

Group Hostility

[illegible]

Active management radically less a tough problem which seems to haffle them. They have changed the drama in advancing the new era of the private. Now they are started to find their employees, impressed by the propaganda, interested in new working conditions. No one seems to be able to approach the existing problems, depression only, and no final solution in a period of studies and other health care.

Flight response and pilot through their respective organisations differ over the responsibilities of the third uniting member of the cockpit crew. The products of the air-traffic situation whereby three men functioning as a work unit the use of a single cell belong to two cases which are basic and not necessarily representative.

Everyone is flummoxed over the nuclear collection problem. Your responsibility is to ensure that security by tending to dispense in dividends and groups rather than regarding the situation as a continuous problem.

It will not solve the problems of

Academic Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Academic Week*, 330 W. 42nd St., New York 36, N. Y. To keep letters under 300 words and give a precise identification. We will not print unnumbered letters, but names of writers will be withheld on request.

few examples. One student's before and after statements are not only as significant as the first example, but are also more complete. The student's before statement is not just a list of problems, but includes a description of the student's feelings. Indeed, the list expands and becomes a short, unorganized philosophical and sociological "Maie hauru" relationship. In an interview, the student discussed problems that he had not put in his before statement. He had been "too shy" to say that some of these had occurred to him. He had been so much in awe of your comments that he had been afraid of giving you the wrong impression. He was also not willing to say that he had been thinking of dropping out of school. Remember, the student's after statement is more than a list of problems. It includes a description of the student's feelings about what the relationship is like now.

Western Kentucky
Bridges, Bailey, Cline

'Security Snoopers'

Years editorial "Global: After Process of Peace" (AFC Dec 29 p 131) refers to news "deliberate manipulation of the news under the guise of military necessity." "We have people who think they must know everything about defense programs in order to be able to interpret the so called news made for the public. We also have some of the public who are deeply interested in some news but not that news that would be in public interest in general news."

We believe in free democratic elections and further believe it should be rid of security intrusions under the guise of newspaper people, Mass. Americans as well as our allies do not want to know security news but prefer unadorned news of the type that no laws will not be of interest in our country. Some of us who have been in the front lines support the need secret and respecting it have found the greatest security lies.

1 W. BARNES
1666 South Street Drive
Barnes, Pa.

Glider Training

The underlying though related discovery of the USF is expanding its college ROTC flight program and instead some people. Quote "Indians are that 'worth' not afford me to live training at USF primary schools has been held on a scale of lightphobic construction in colleges" (NW Jan 19 p. 111)

The CAA, through Captain Pilot Training, proved that post conclusively to the Army, Navy, Marines and Coast Guard in the late 1950s and early 1960s, and most nationwide education will know it.

with it that time. The only reason the CAA couldn't put across the budget point was lack of lobbying experience. The coalition emerged with the 165 score, experience the

As NAA, hypertonic Glider Pilot #14, I should like to point out that flies would not matter and students in going "shock" late. If they start with glider, they will find what goes, glider pilot knows. 100 lbs. back, a handful of time, and, flies will be a more, students, and, some.

A. C. "Doc" HILLMAN
Aircraft Maintenance Technician
U. S. Army
Table No.

P. S. Dig into the skin, and first I found the Luftwaffe. When I was studying in Germany in 1948, there were 12,000 glider pilots between the ages of 14 and 20.

Safety Factor

A street wharf-hopping feeding of a common eel attracts, among 75 persons attracted, noticeable attention through pace and tale vibration activity. The eel and the pole trailing five lines of swimmers was probably the result of a captured fish in the hydraulic system.

There it unfolds a device known as a "Hydraulic Foot" whose function is to protect against such occurrences. Hydraulic feet have met with wide acceptance and broad usage in military systems to provide the type of protection. While the military has considered this a qualified use since 1946, particularly in commercial vehicles have been given the advantage of the additional safety factor.

The cost of equipping all existing cars with airbags, with the protection would be a small fraction of the cost and gain which results from one major accident.

H. HIRAKAWA
Manager, Special Design
Mechanical Engineering Co.
Osaka, Japan

Tu-104 Routes

[illegible]

Malcolm Hanson
Former USAF Reserve Officer
Airborne: May
(May showed that the Tu-16 has varied
on demonstration and theater fights, in
addition to cruise routes.—Ed.)



Efficiency Rustlers?...

Fastbolt's got 'em covered

In the early days, when a mariner had to adjust the aim of his shooter's eye, the only method he could use was "Kentucky Windage." Now, thanks to modern instruments what was once dependent on guess and chance, can be scientifically calculated with a minimum of error.

Area greater advances have been made in the field of overall fastening. The combination and non-consuming method of **hook-nitch fastening** has given way to efficient, accurate, present day methods. The Fastbolt System represents the ultimate in modern progress. Incorporating all the advantages of nuts and bolts, and of riveted and welded assemblies, the Fastbolt System brings increased speed and versatility to the production line. Get the "idea" on applications here — with Fastbolt.

**LETE COVERAGE
AND MISSILE
& REQUIREMENTS...**

Only ESNA® offers all three locking devices

The Red Nylon Locking Collar for maximum performance under severest conditions of vibration, impact, re-use . . . to 250° F.



The Offset Locking Oval for thin-walled, lightweight, miniaturized fasteners . . . 550° F and 900° F.



The "Z" or Locking Beam standard of the engine industry for high performance at very high temperatures . . . to 1300° F.



Fit the fastener to the application from the only complete line of self-locking fasteners



ELASTIC STOP NUT CORPORATION OF AMERICA

It takes more than one locking device to cover the specialized requirements of the aircraft and missile industries. One of the three devices offered by ESNA . . . and only ESNA . . . is sure to have the required qualities for each specific application.

That's half of ESNA's story. The other . . . and equally important half . . . is the tremendous variety of special shapes and sizes available with each locking device. Whatever your fastening requirements, there's an Elastic Stop nut designed to do the job. Mail in the coupon for design information on the full line . . . or recommendations for your particular fastening requirements.

Dept. 528-225, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

- ☐ Visual index: A complete pictorial representation of all standard Elastic Stop Nuts. ☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name _____ Title _____

Firm _____

Street _____

City _____ Zone _____ State _____